THE PROCESS OF ACHIEVING COLLABORATIVE KNOWLEDGE IN ASYNCHRONOUS COLLABORATION (CASC)

Project Update

Collaboration and Knowledge Management Workshop
January 11-13, 2005

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AGENDA

- ***Project Overview***
- ***Technical Plan***
  - Science Concept Researched
  - Contribution to Collaboration Technology
- ***Project Status***
  - CASC Phase II Experimental Design & Data Analyses
  - Phase II Results
  - Phase II Conclusions
  - CASC Team Collaboration Model Representation
  - FY 05 Plans
- ***Transitions***
  - ForceNet
  - Special Warfare
- NAVAIR Testbed Ewall Demonstration with Special Warfare Scenario
- ***FY04 Accomplishments***

PROJECT SUMMARY OVERVIEW

• **Overall Goal:** **understand the unique cognitive mechanisms that should be employed to optimize collaborative decision-making activity in a geographically distributed and time-delayed situation**

• **Objectives:** **(1) to understand the cognitive process of building knowledge in an asynchronous, distributed collaboration environment**

(2) to develop an empirically-based theory of collaboration, including knowledge building components, during asynchronous, distributed collaboration

(3) to understand how agents can support humans in achieving collaborative knowledge during asynchronous, distributed collaborative problem solving

• **FY 04 Objectives:**

(1) Conduct experiments in collaborative problem solving in both face-to-face and asynchronous, distributed environments to understand the unique cognitive processes within asynchronous, distributed collaboration (emphasis on Collaboration Mode & Knowledge Uncertainty)

(2) Update model of collaboration based on experimental results

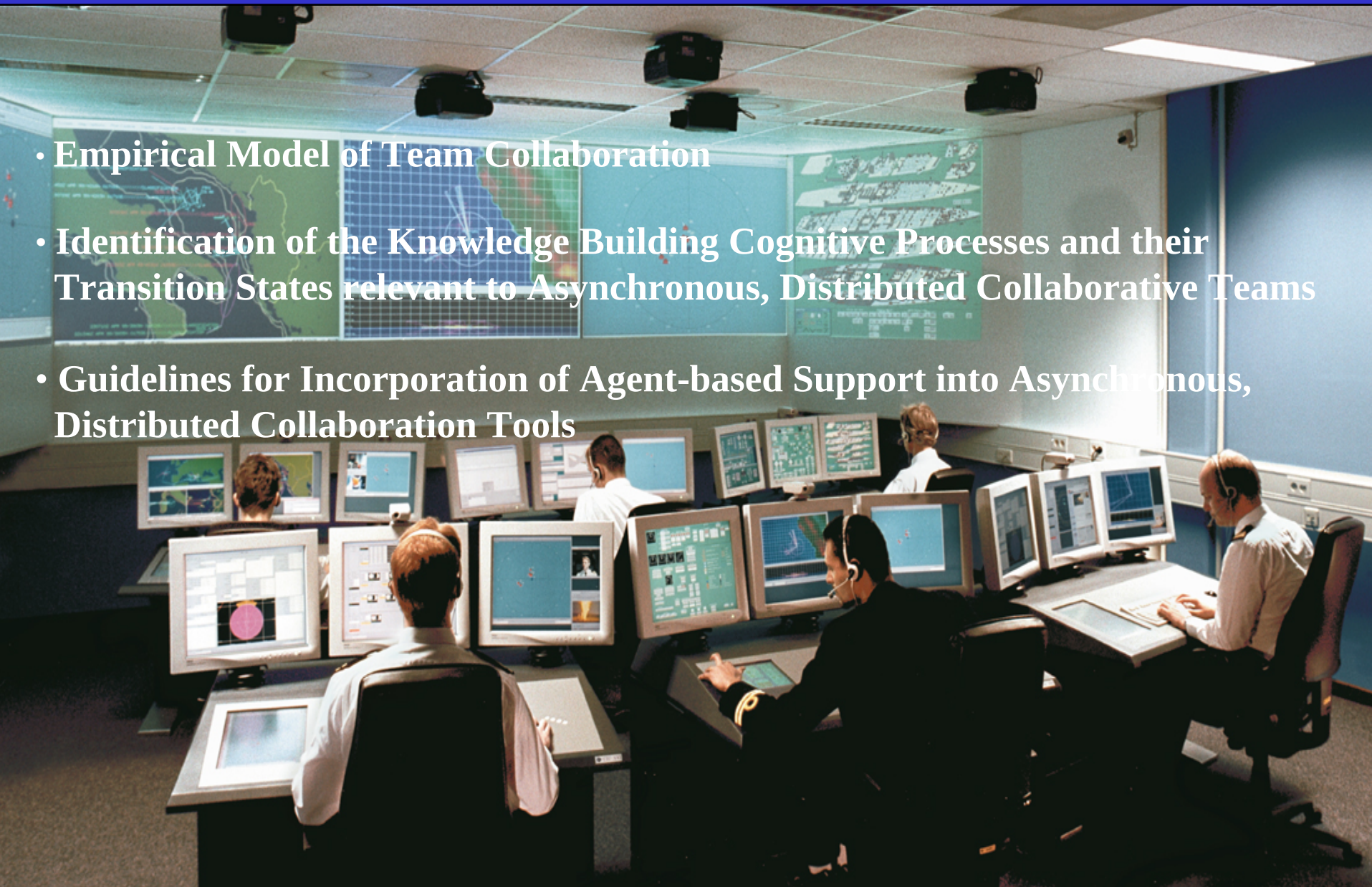
Science Concept Researched:

- **What is the knowledge building process humans use in asynchronous, distributed collaborative problem solving?**

- **Understand the effect of the following variables on the knowledge building process during asynchronous, distributed collaboration?**
  - *** Collaboration Modes (face-to-face versus asynchronous, distributed)**
  - *** Knowledge Distribution (homogeneous versus heterogeneous)**
  - *** Knowledge Uncertainty (static knowledge versus dynamic knowledge)**

- **What forms of agent support facilitate knowledge building in asynchronous, distributed collaborative problem solving?**

TECHNICAL PLAN
Contribution to Collaboration Technology



- **Empirical Model of Team Collaboration**
- **Identification of the Knowledge Building Cognitive Processes and their Transition States relevant to Asynchronous, Distributed Collaborative Teams**
- **Guidelines for Incorporation of Agent-based Support into Asynchronous, Distributed Collaboration Tools**

Project Status
CASC Phase II Experiment

- **Collaboration Task:**
  - **Expanded NEO Mission Scenario (Warner, Wroblewski, Shuck, Cowen, Letsky, 2003)**

    *** developed with expertise from operational personnel (Navy Seal, Marine, Army aircrew)**

  - **Mission Statement ---**

    The time is 2:00am, January 15. Your mission is to rescue 3 stranded Red Cross workers from a church basement, on a remote island, caught in the middle of guerilla warfare, within 24 hours. The situation is described in the next few pages along with the assets of US forces which are available to rescue the workers. You need to work together and develop a course of action (using ANY assets available to you), which includes a plan for getting to the church, a plan for evacuating the workers, and a plan for the return to the Army base or aircraft carrier. The course of action solution can be an Army, Marine, Navy Seals solution, or a combination of the assets of the three. You want to choose the optimal and most efficient solution. You want to minimize damage to the village and villagers; you want to avoid contact with enemy if possible, and to rescue the workers safely. However, the rules of engagement are that any forces will defend themselves if needed. Good Luck!

- **Asynchronous, Distributed Collaboration Environment:**
  - **Modified Ewall workstation and visualization area**

- *Collaboration Mode* (face-to-face vs asynchronous, distributed)

  * Face-to-Face = team interacts synchronously with each other through speech

  * Asynchronous, Distributed = team interacts with each other at different times and from different locations through the Ewall collaboration environment

- *Knowledge Uncertainty* (static vs dynamic knowledge)

  * static knowledge = all information (I.e. background information, rebels, Navy Seals, Marine and Army assets, Intell, weapons and environment expertise information) remains the same throughout the collaborative NEO scenario problem

  * dynamic knowledge = Selected information (I.e. rebel location and weather) changes at a standard time in the collaborative NEO scenario problem

CASC PHASE II EXPERIMENTAL DESIGN

(2x2 randomized factorial)

Knowledge Uncertainty

Collaboration Mode	Static	Dynamic
Face-to-Face (speech)	Gp 1 * * Gp 8	Gp 17 * * Gp 24
Asynchronous, Distributed (Ewall –text, pictures)	Gp 9 * * Gp 16	Gp 25 * * Gp 32

Phase II

- 32 groups total
- 3 subjects / group
- 96 subjects total

DEPENDENT VARIABLES:

- Ewall cards and face-to-face audio / video recordings including time stamp per response (I.e. cards and speech)
- Quality of Decision (scoring of the team's final plan against final plan developed by an operational team consisting of Marine, Army,and SEAL personnel)
- Total time to successfully complete the problem-solving task (time from the beginning of the task until task completion)
- Collaboration Maps (post session – subjects construct a map of their view of the stages & cognitive process states of team collaboration)
- Subjective Questionnaire – measuring expertise, trust between team members, and general collaboration opinions among members

TYPES OF DATA ANALYSES
Phase I, and II Experiments

- **Verbal Protocol Communication Analyses– identification of collaboration stages and cognitive process states compared across collaboration mode and knowledge uncertainty. Compare results to model of collaboration.**

- **Transition State Diagrams – representation of the *dynamic* team collaborative behavior between collaboration stages and between cognitive process states within each collaboration stage compared across collaboration mode and knowledge uncertainty. Compare results to model of collaboration.**

- **Parametric statistics for analyzing time, and frequency within each collaboration stage and cognitive process state across collaboration mode and knowledge uncertainty conditions. Also used for analyzing quality of decision, total time to complete task and questionnaire data.**

- **Collaboration Maps – determine the degree of convergence between individual mental model 's regarding collaboration stages and cognitive processes. In addition, compare how an individual thinks a group makes a decision in a collaborative setting and how the group actually performs.**

NAVAIR

COGNITIVE AND AUTOMATION RESEARCH LAB (CARL)

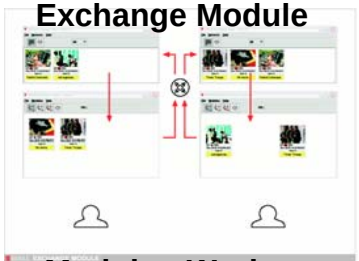
Asynchronous, Distributed Collaboration Stations

Experimenter's Station

Face-to-Face Collaboration Area

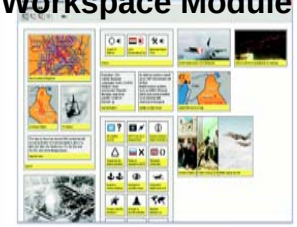
Electronic Card Wall Collaboration Tool (Ewall)**

Exchange Module



Newsview Module

Workspace Module



** Produced by MIT under ONR CKM program

Experience & Capabilities

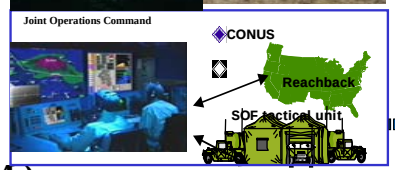
- **Over 25 Years Experience in Decision Making / Automation Research**
- **Member National & International Research Panels**
- ***Recent efforts*: CASC, Agent Learning, ADSS, ANGEL, SCC**
- ***Tools*: local web server, Pathfinder, Agent development toolsets, Statistica**
- **Joint efforts (e.g. NAVAIR TSD, JFCOM,)**

Potential Applications

Users

Improved pilot SA Resulting in timely Mission performance

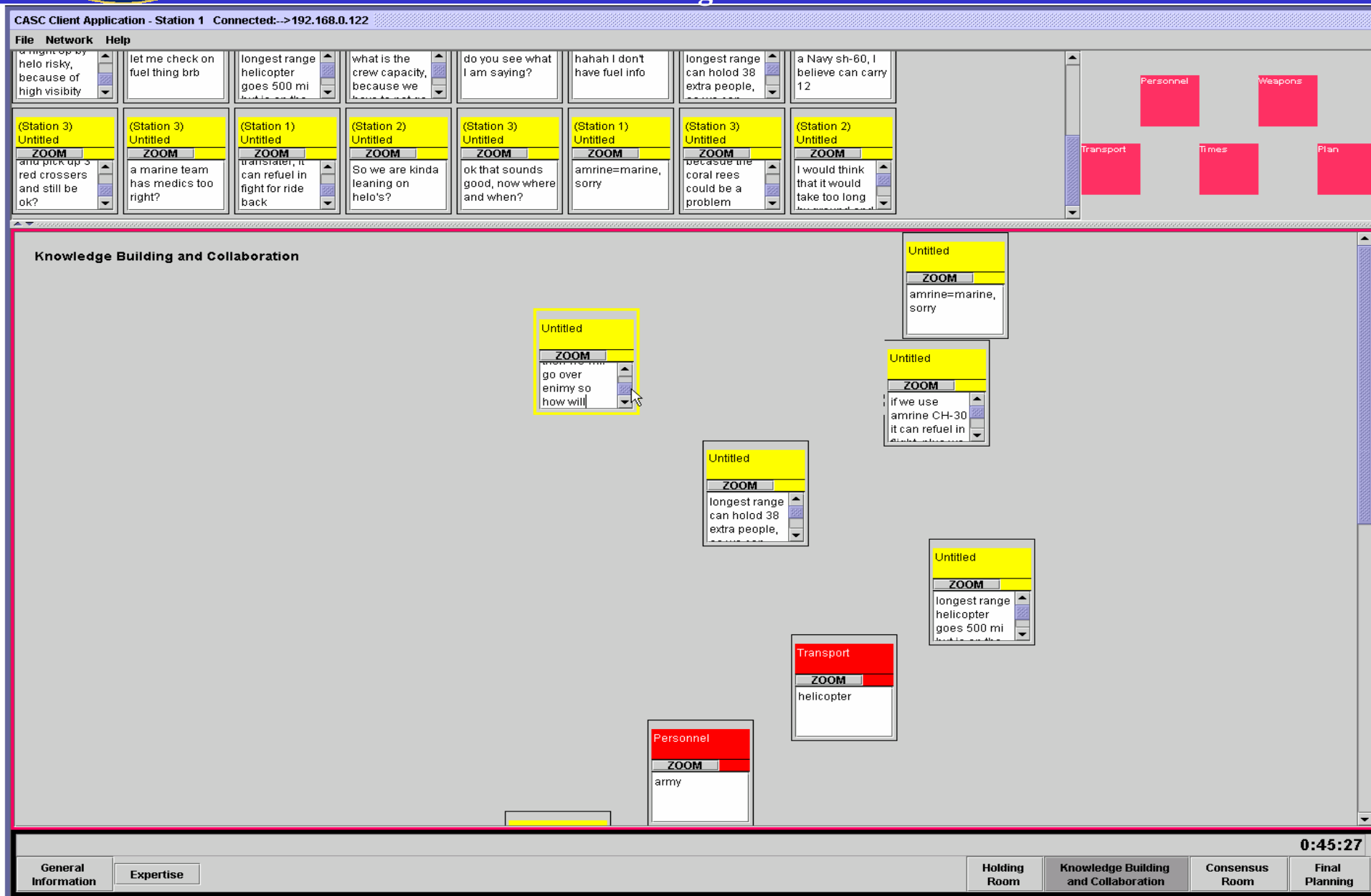
- **More timely and accurate mission decisions based on current information achieved through asynchronous, distributed collaboration tools (C2 down to individual warfighter)**



- **Improved mission planning and execution through networked asynchronous, distributed team collaboration tools.**

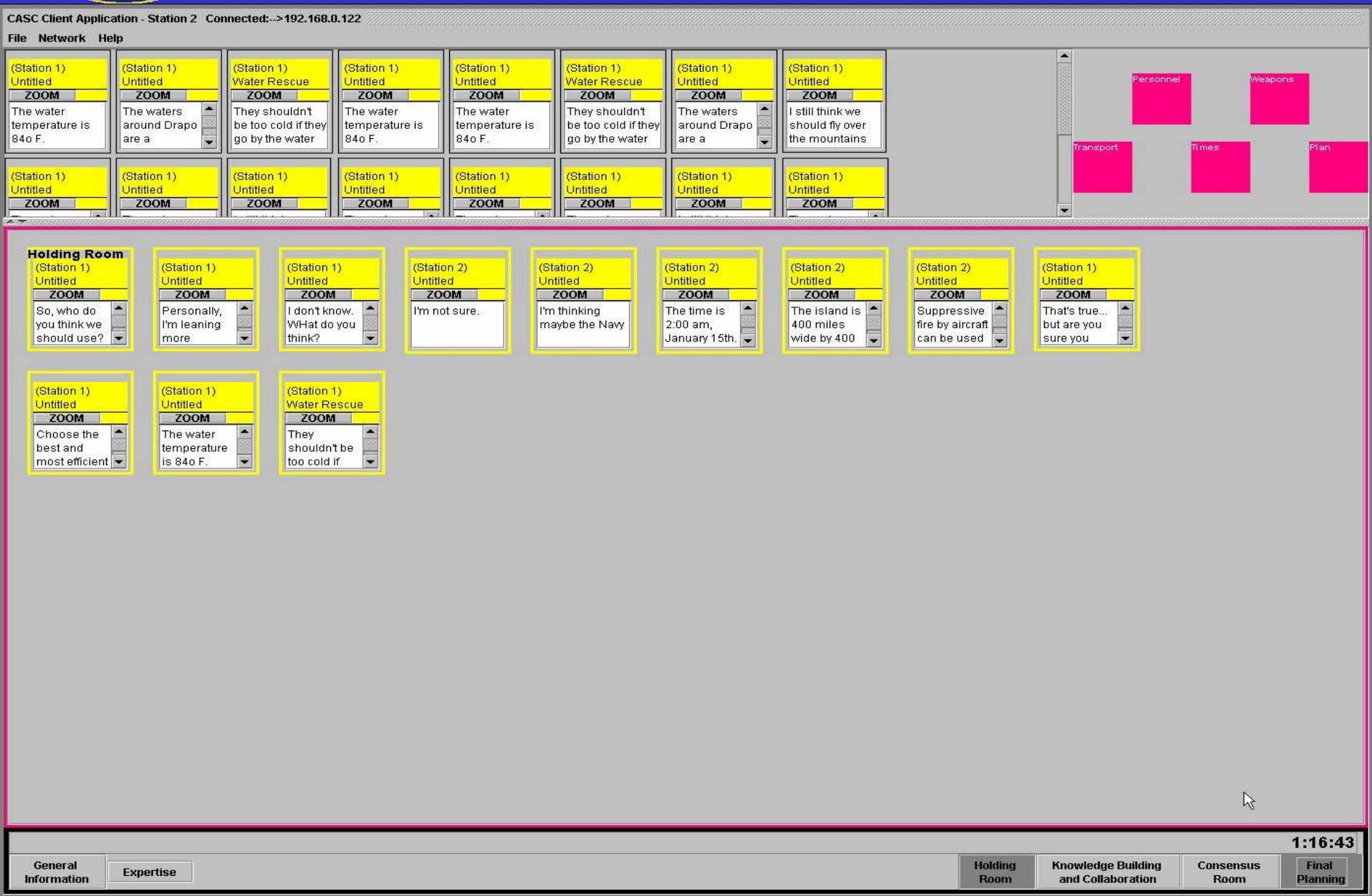
CASC Phase II Experiment

Modified Ewall Display: Collaboration & Knowledge Building



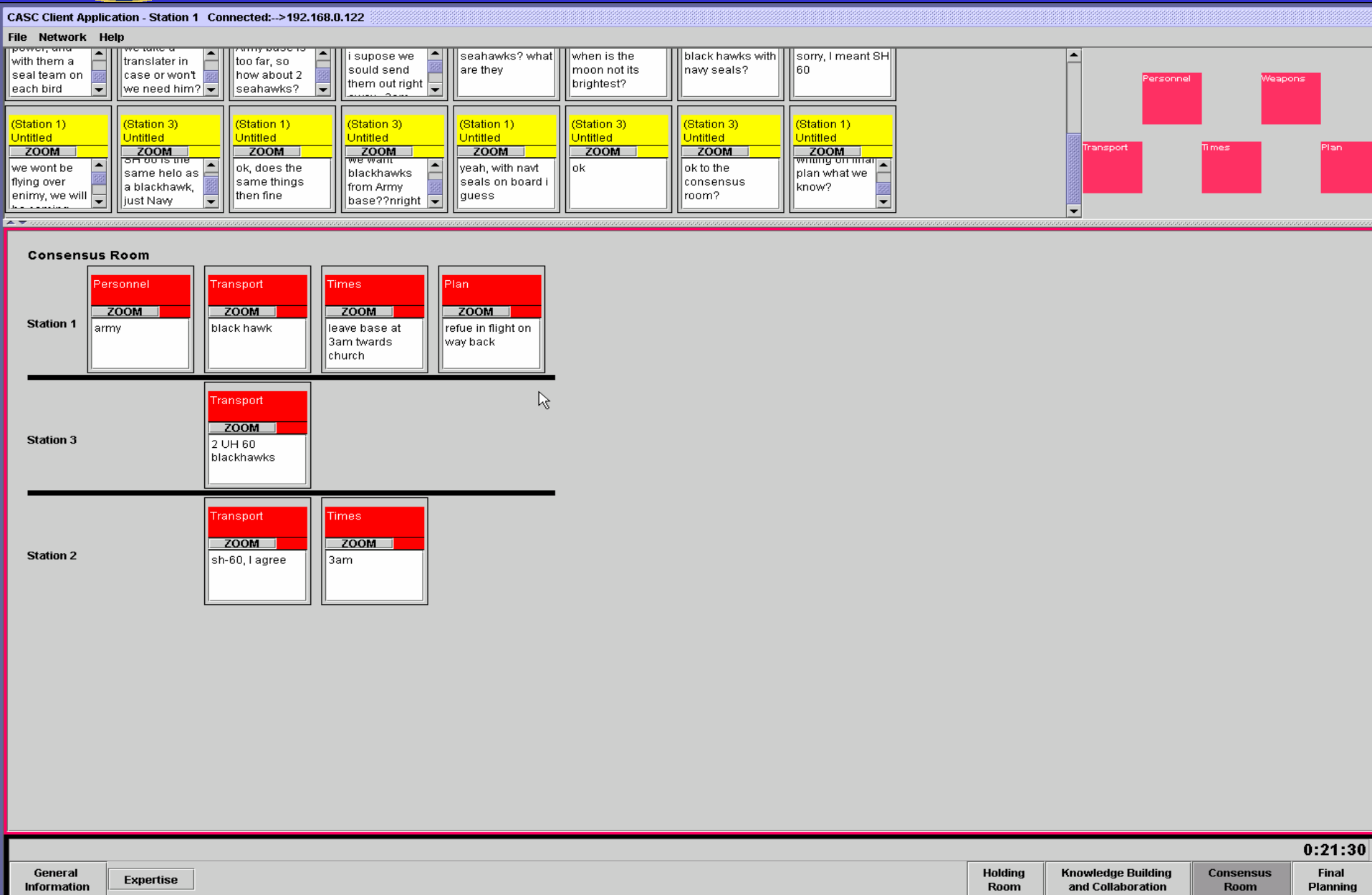
CASC Phase II Experiment

Modified Ewall Display: Holding Room



CASC Phase II Experiment

Modified Ewall Display: Consensus Room



CASC Phase II Experiment

Modified Ewall Display: Final Planning

CASC Client Application - Station 1 Connected:-->192.168.0.122

File Network Help

I think so	9pm would be better, helo goes 184m/hr	this before the sun comes up today	prep...manpower wise you know?	Are we still refuling on way back?	ok, how many miles from base to church?	sunrise is at 6am..so 5 would be too late	yes on refule Q
(Station 3) Untitled ZOOM yes refueling	(Station 3) Untitled ZOOM y'all decide on time, I just don't hink day	(Station 1) Untitled ZOOM well it's either 3am (night) or 9pm (night)	(Station 1) Untitled ZOOM put for wepons, riflemen	(Station 3) Untitled ZOOM	(Station 2) Untitled ZOOM lets stick with the arrive 3 am	(Station 3) Untitled ZOOM sorry, how many seals g	(Station 3) Untitled ZOOM sorry, how many seals go in the church

Personnel Weapons Transport Times Plan

Final Planning Room

Personnel	Transportation	Weapons	Critical Times	Detailed Plan	Additional Comments
2 teams of SEALS	2 uh-60 Blackhawks		Onset: 2:15 am Contact: 3:00 am Evacuation: 3:30 am Return: 4:15 am	Fly to church pick up red cross workers and refueling on way back	

Untitled ZOOM times are wrong, we can't start at 2, it's

Final Submission

0:03:13

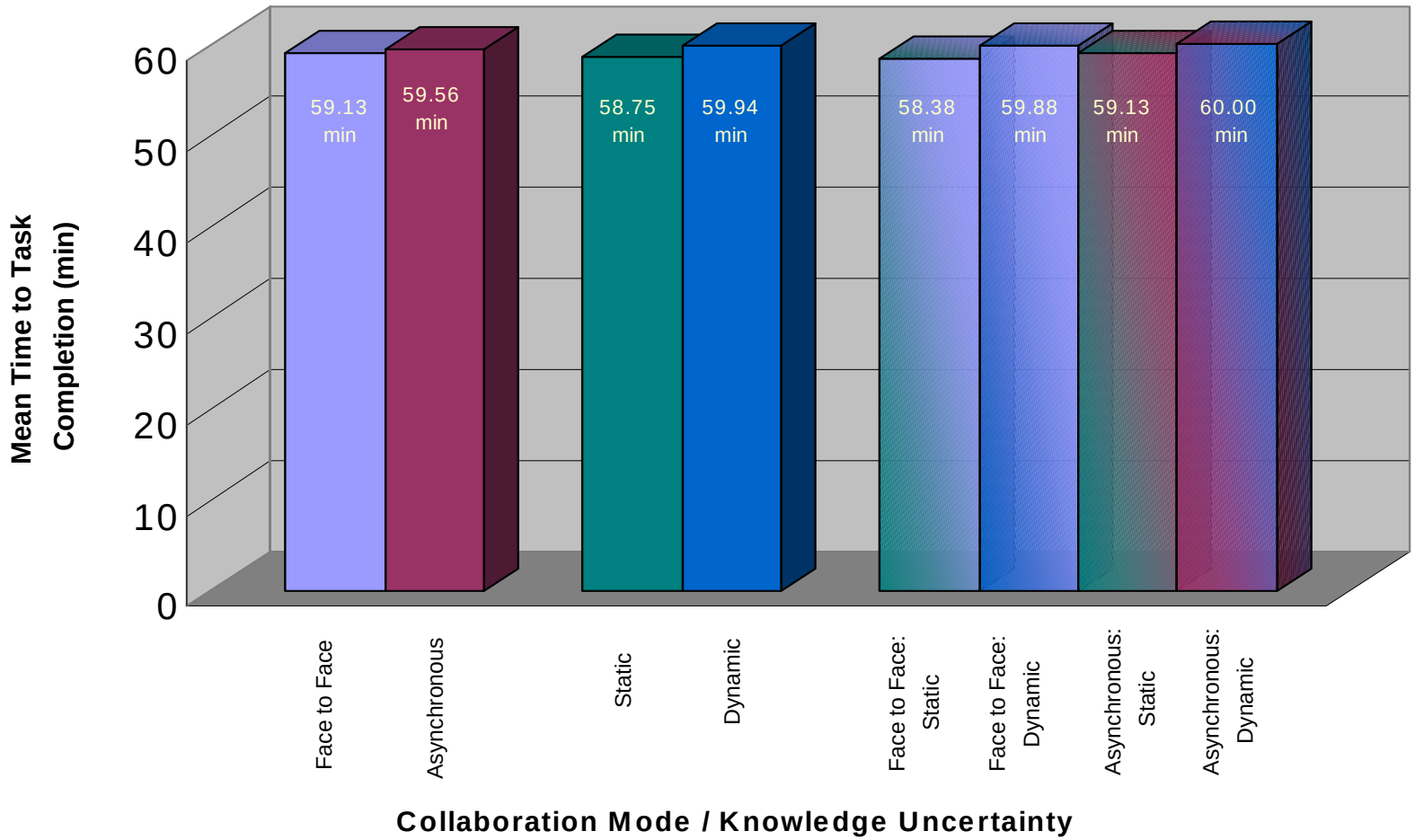
General Information | Expertise | Holding Room | Knowledge Building and Collaboration | Consensus Room | Final Planning

Project Status

CASC Phase II Results (parametric)

Mean Time to Task Completion by Collaboration Mode and Knowledge Uncertainty

Collaboration Mode: F = 0.26, p = 0.616993
Know ledge Uncertainty: F = 1.88, p = 0.180729
Collaboration Mode * Know ledge Uncertainty: F = 0.13, p = 0.720626
N = 32 (Teams)

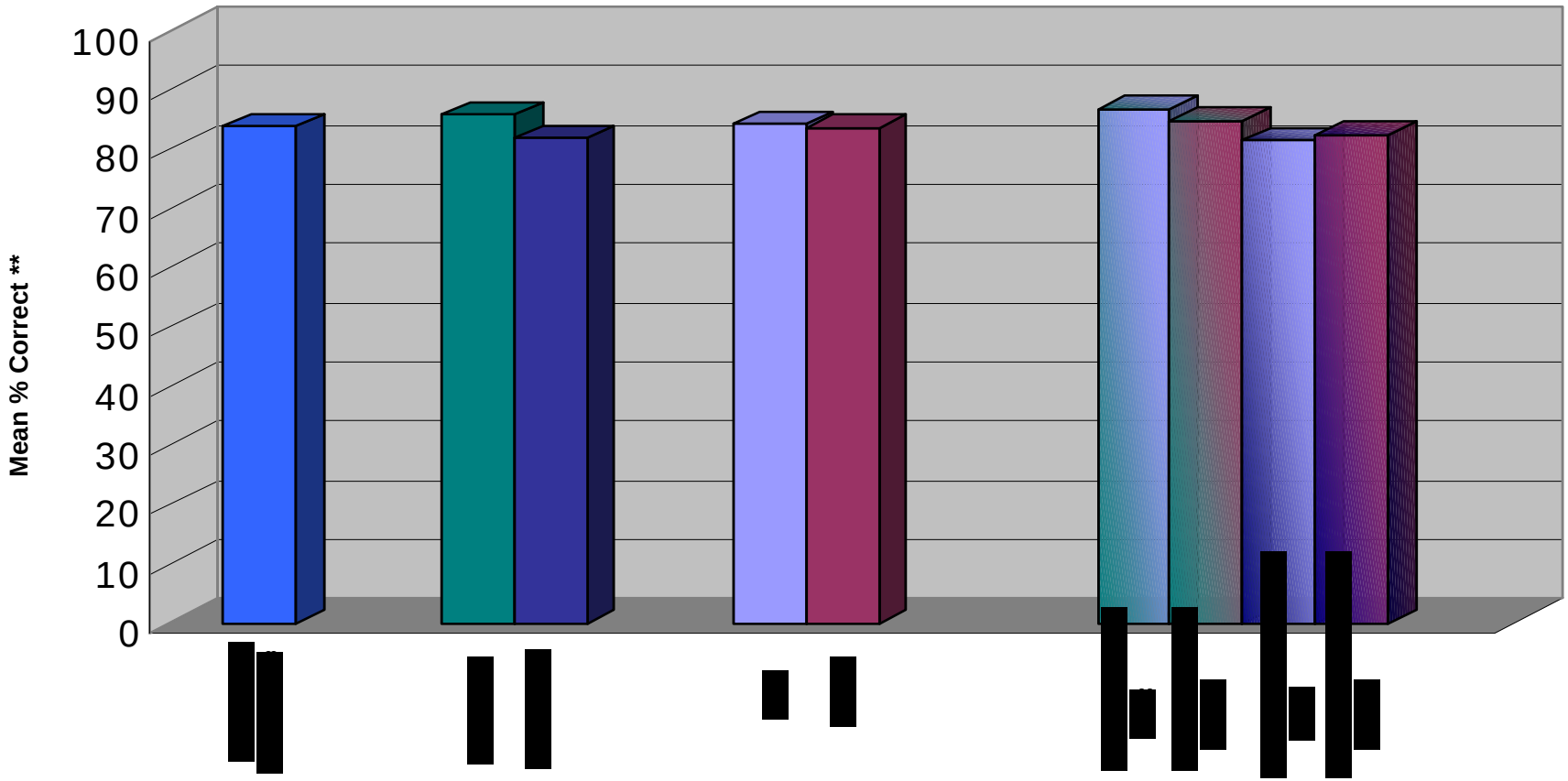


Project Status

CASC Phase II Results (parametric)

Quality of Decision by Collaboration Mode & Knowledge Uncertainty

Collaboration Mode: F = 2.366, p = 0.135268
Know ledge Uncertainty: F = 0.072, p = 0.790249
Collaboration Mode * Know ledge Uncertainty: F = 0.372, p = 0.546568
N = 32 (Teams)

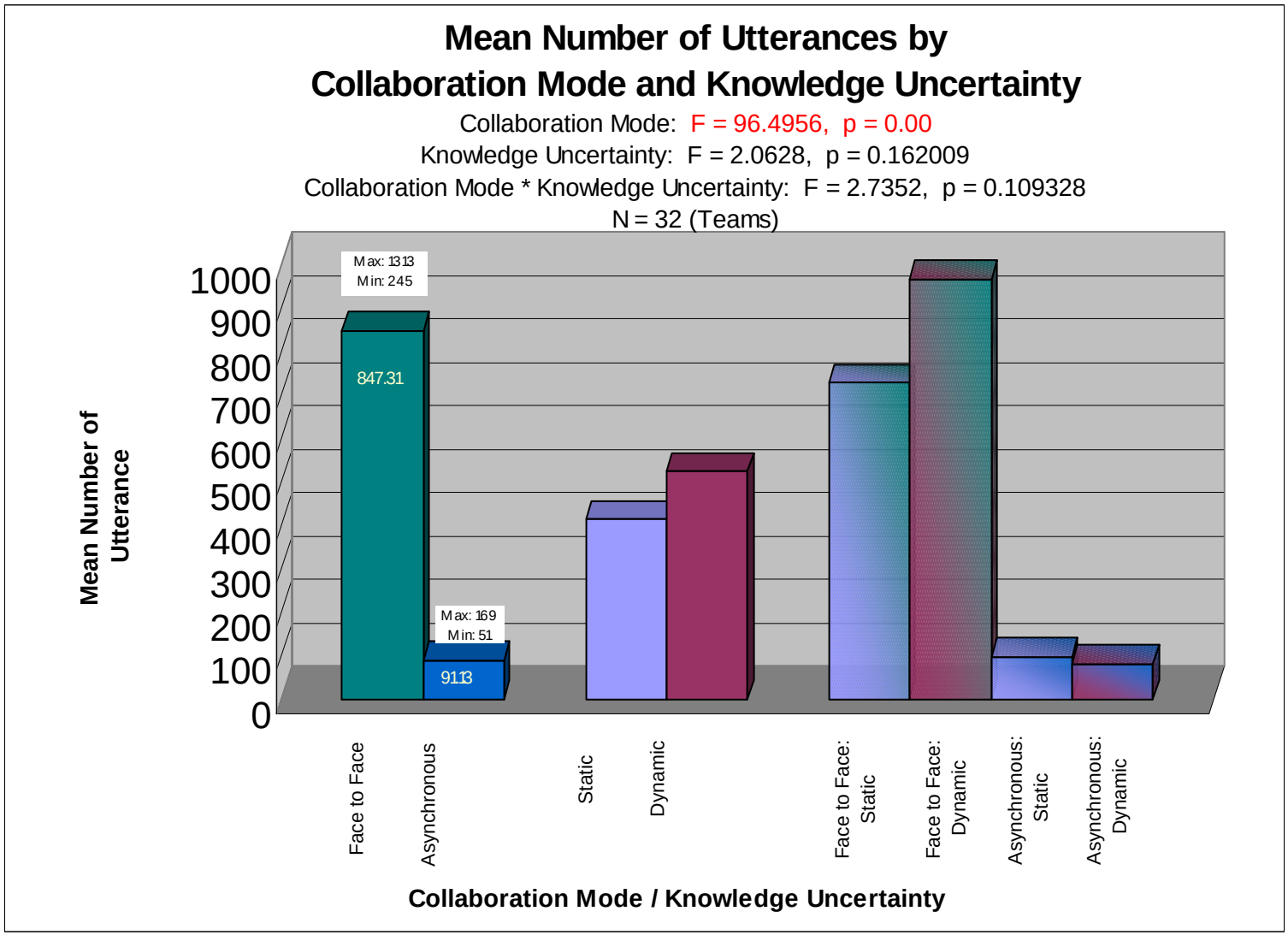


** Based on scoring criteria found in Appendix A

Collaboration Mode / Know ledge Uncertainty

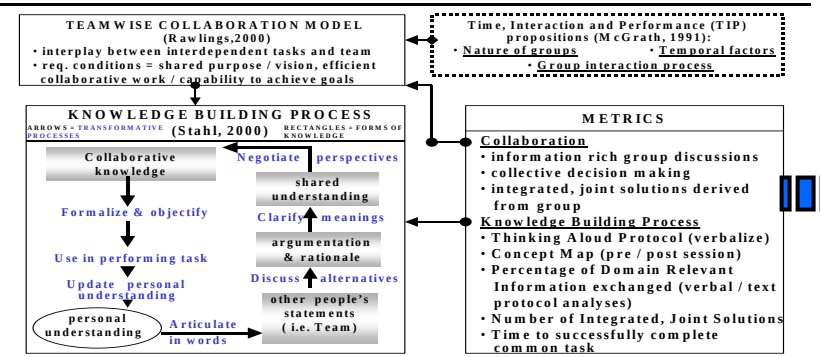
Project Status

CASC Phase II Results (parametric)

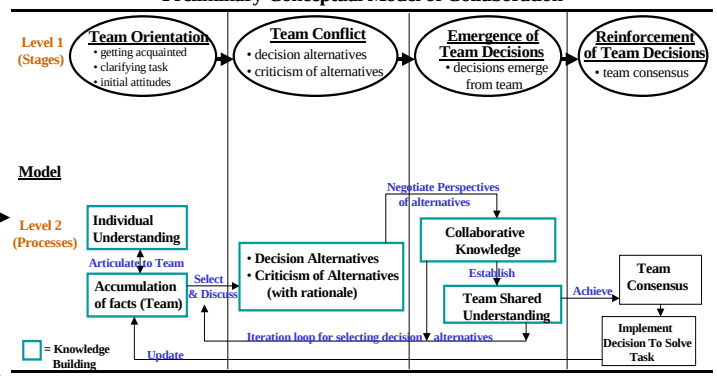


Model Evolution of Team Collaboration
(September 2002 –September 2004)

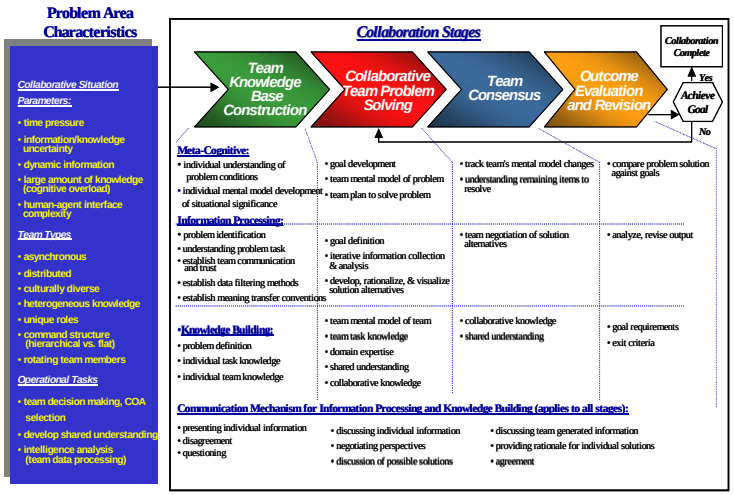
INITIAL THEORY FOR ACHIEVING COLLABORATIVE KNOWLEDGE IN ASYNCHRONOUS COLLABORATION



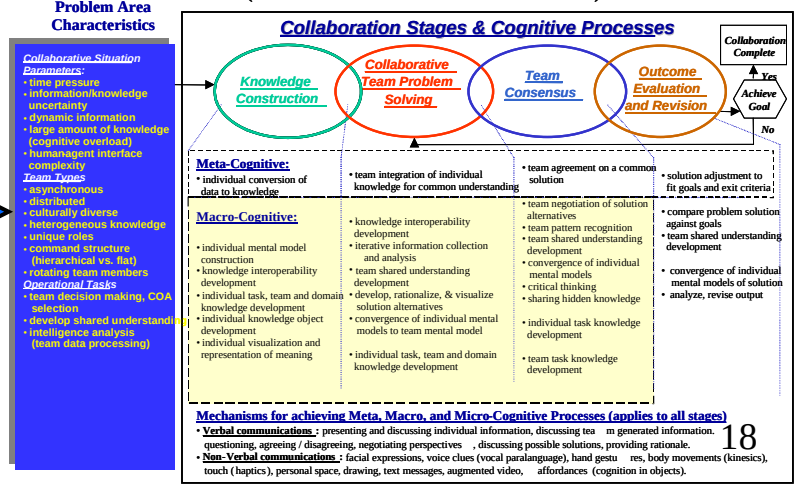
Preliminary Conceptual Model of Collaboration



STRUCTURAL MODEL OF TEAM COLLABORATION



MODEL OF TEAM COLLABORATION (MACRO-COGNITIVE PROCESS FOCUS)



MODEL OF TEAM COLLABORATION
(MACRO - COGNITIVE PROCESS FOCUS)

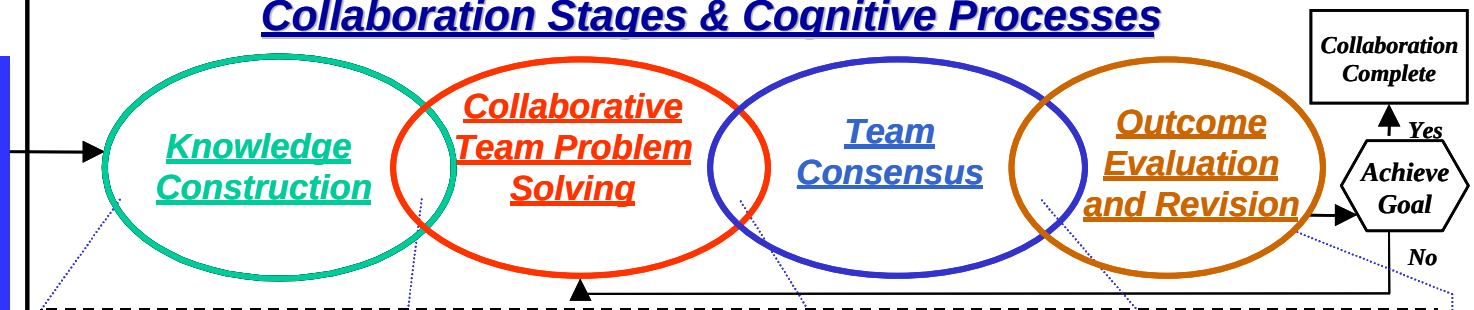
Problem Area Characteristics

Collaborative Situation Parameters:
- time pressure
- information/knowledge uncertainty
- dynamic information
- large amount of knowledge (cognitive overload)
- human-agent interface complexity

Team Types
- asynchronous
- distributed
- culturally diverse
- heterogeneous knowledge
- unique roles
- command structure (hierarchical vs. flat)
- rotating team members

Operational Tasks
- team decision making, COA selection
- develop shared understanding
- intelligence analysis (team data processing)

Collaboration Stages & Cognitive Processes



	Knowledge Construction	Collaborative Team Problem Solving	Team Consensus	Outcome Evaluation and Revision
Meta-Cognitive:	• individual conversion of data to knowledge	• team integration of individual knowledge for common understanding	• team agreement on a common solution	• solution adjustment to fit goals and exit criteria
Macro-Cognitive:	• individual mental model construction • knowledge interoperability development • individual task, team and domain knowledge development • individual knowledge object development • individual visualization and representation of meaning	• knowledge interoperability development • iterative information collection and analysis • team shared understanding development • develop, rationalize, & visualize solution alternatives • convergence of individual mental models to team mental model • individual task, team and domain knowledge development	• team negotiation of solution alternatives • team pattern recognition • team shared understanding development • convergence of individual mental models • critical thinking • sharing hidden knowledge • individual task knowledge development • team task knowledge development	• compare problem solution against goals • team shared understanding development • convergence of individual mental models of solution • analyze, revise output

Mechanisms for achieving Meta, Macro, and Micro-Cognitive Processes (applies to all stages)
- **Verbal communications**: presenting and discussing individual information, discussing team generated information. questioning, agreeing / disagreeing, negotiating perspectives, discussing possible solutions, providing rationale.
- **Non-Verbal communications**: facial expressions, voice clues (vocal paralanguage), hand gestures, body movements (kinesics), touch (haptics), personal space, drawing, text messages, augmented video,affordances (cognition in objects).

CASC Phase II Results
(verbal protocol analyses)

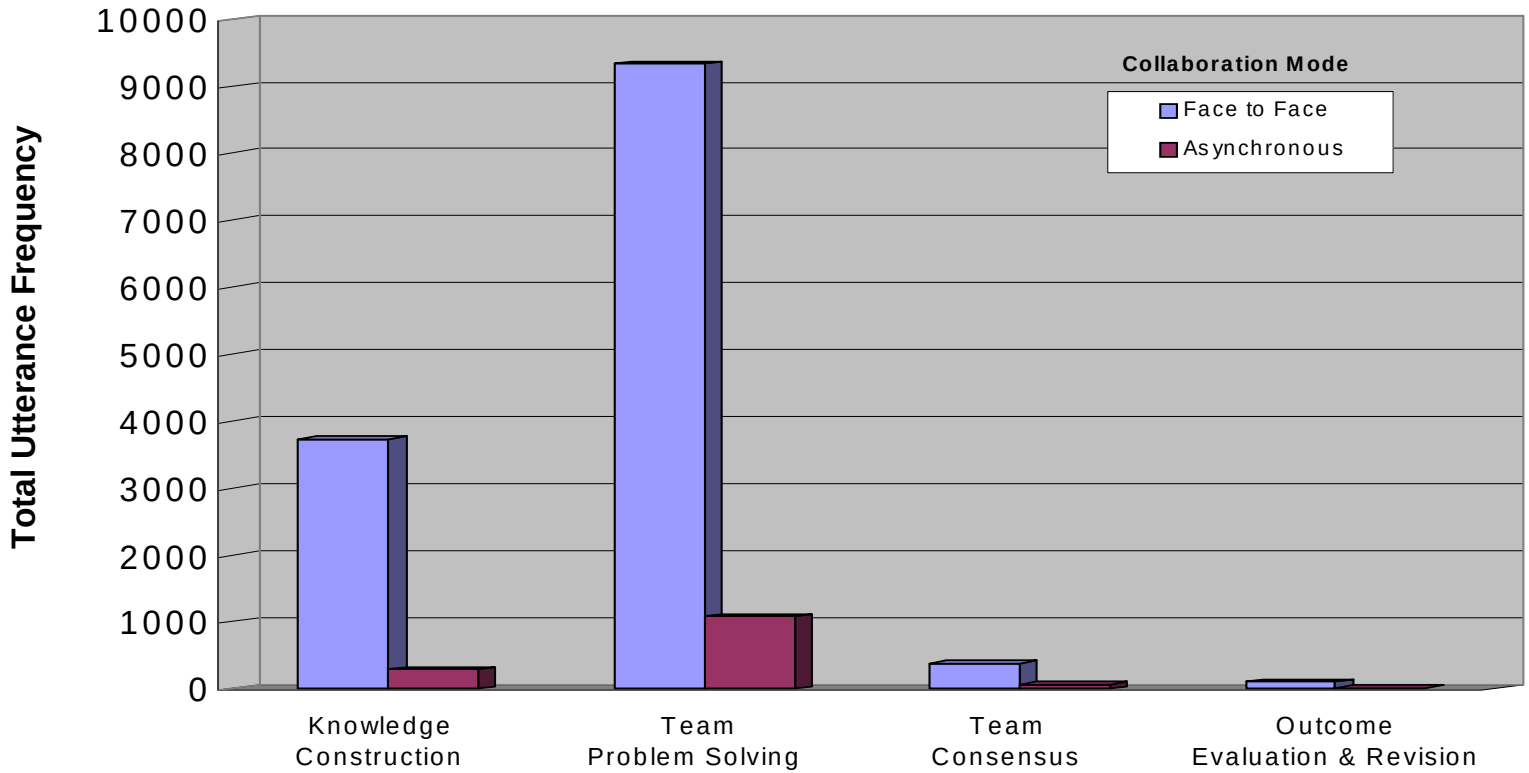
Total Utterance Frequencies by Collaboration Stages & Collaboration Mode

Knowledge Construction
CM: F = 60.81317, p = 0.00
KU: F = 0.22663, p = 0.637727
CM*KU: F = 0.33155, p = 0.569348
N = 32 (Teams)

Team Problem Solving
CM: F = 55.27290, p = 0.00
KU: F = 1.66238, p = 0.207833
CM*KU: F = 2.27126, p = 0.142993
N = 32 (Teams)

Team Consensus
CM: F = 26.87553, p = 0.000017
KU: F = 3.75526, p = 0.062786
CM*KU: F = 3.25928, p = 0.081785
N = 32 (Teams)

Outcome Evaluation & Revision
CM: F = 8.12793, p = 0.008094
KU: F = 0.09557, p = 0.759504
CM*KU: F = 0.00118, p = 0.972843



CASC Phase II Results
(verbal protocol analyses)

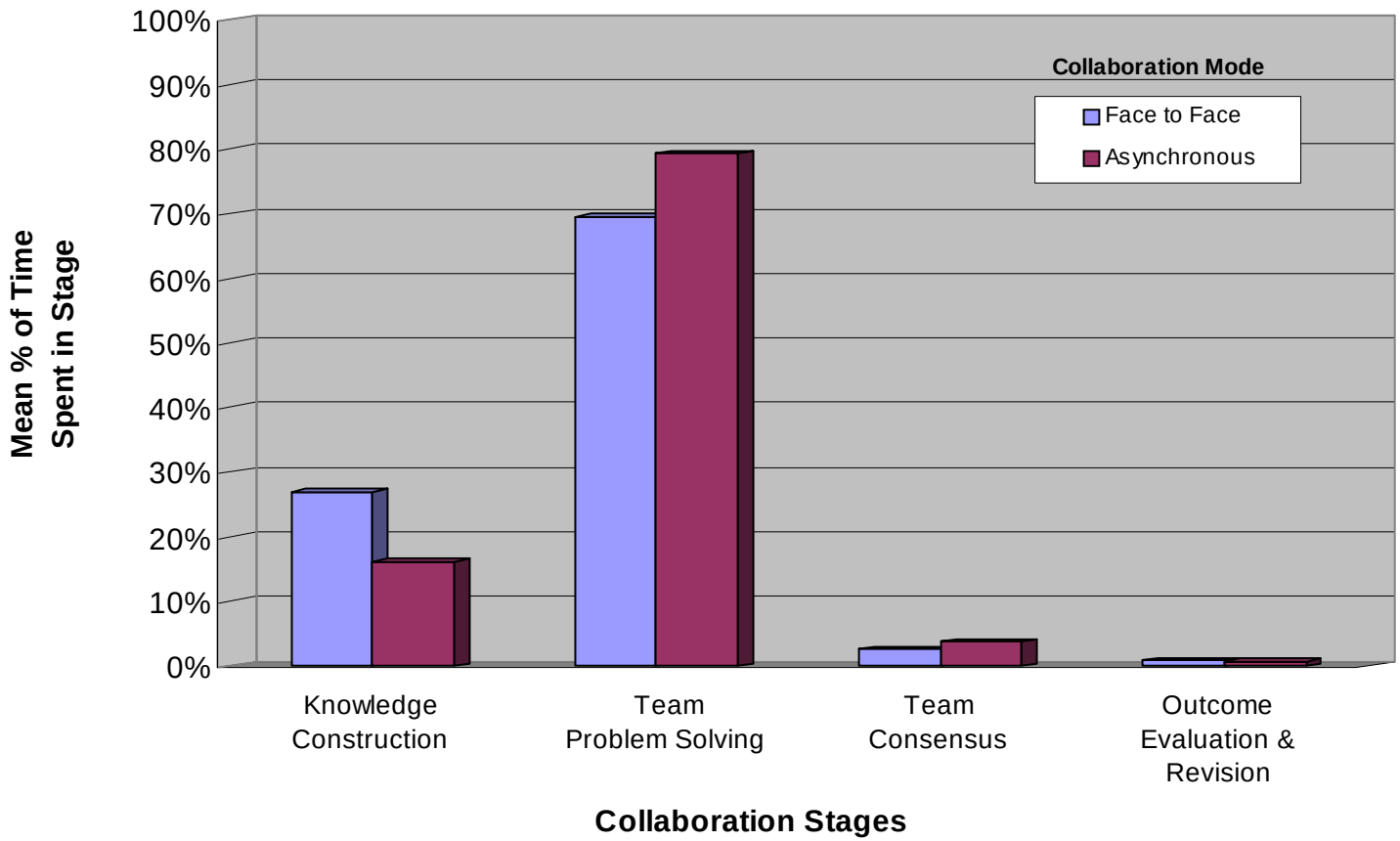
Mean % of Time by Collaboration Stages & Collaboration Mode

Know ledge Construction:
CM: F = 6.5050, p = 0.016512
KU: F = 0.1540, p = 0.697755
CM*KU: F = 0.00, p = 0.995635
N = 32 (Teams)

Team Problem Solving:
CM: F = 5.601, p = 0.025104
KU: F = 0.745, p = 0.395359
CM*KU: F = 0.00, p = 0.990072
N = 32 (Teams)

Team Consensus:
CM: F = 0.81404, p = 0.374624
KU: F = 1.56708, p = 0.220989
CM*KU: F = 0.04719, p = 0.829603
N = 32 (Teams)

Outcome, Evaluation & Revision:
CM: F = 0.08520, p = 0.772517
KU: F = 0.23715, p = 0.630062
CM*KU: F = 0.41881, p = 0.522804
N = 32 (Teams)



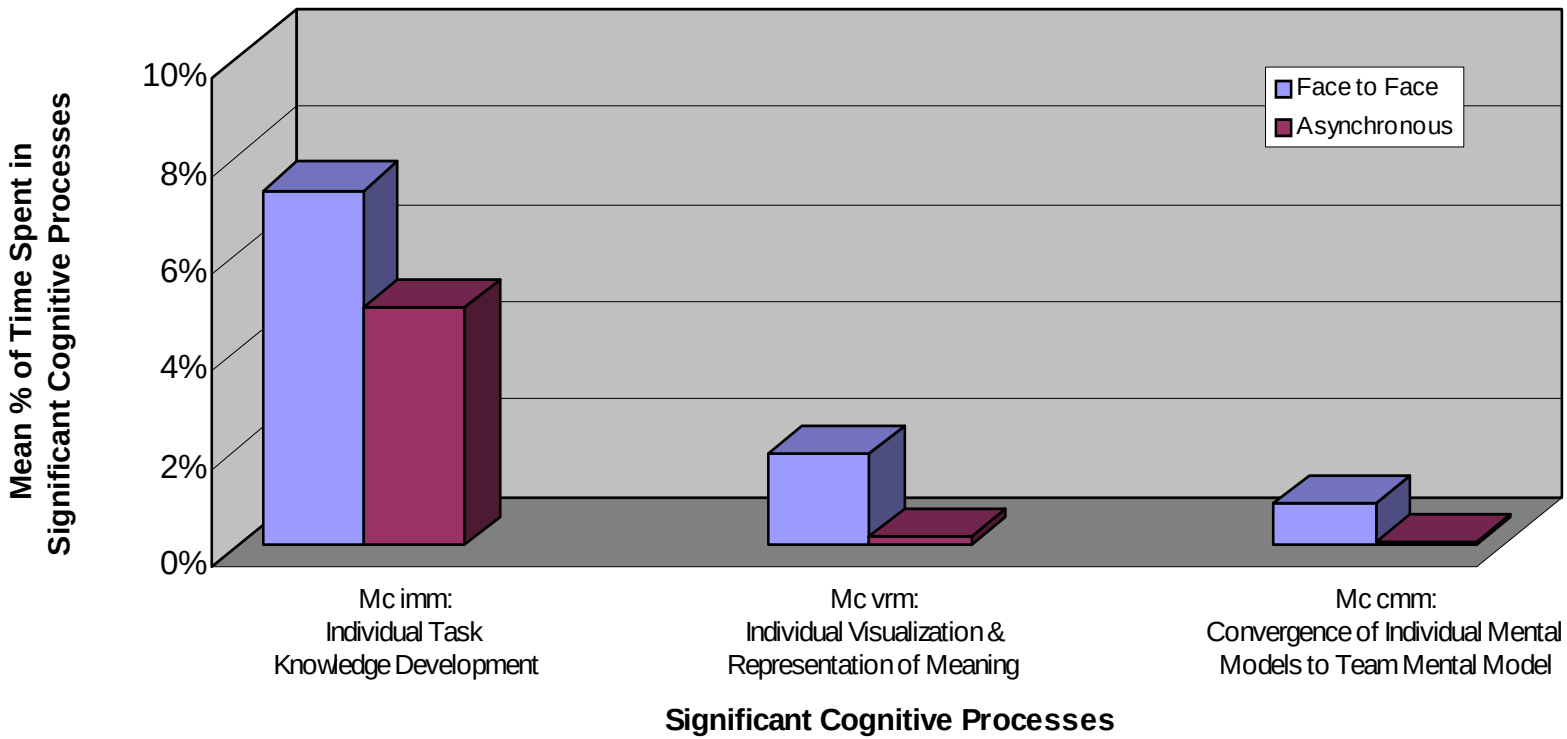
CASC Phase II Results
(verbal protocol analyses)

Mean % of Time Spent in Significant Cognitive Processes by Knowledge Construction

Mc imm:
Individual Task Knowledge Development
CM: F = 4.9790, p = 0.033841
KU: F = 0.0486, p = 0.827031
CM*KU: F = 0.2603, p = 0.613895
N = 32 (teams)

Mc vrm:
Individual Visualization & Representation of Meaning
CM: F = 13.37226, p = 0.001046
KU: F = 0.07915, p = 0.780524
CM*KU: F = 0.25495, p = 0.617562
N = 32 (teams)

Mc cmm:
Convergence of Individual Mental Models to Team Mental Model
CM: F = 12.05386, p = 0.001619
KU: F = 0.35939, p = 0.55366731
CM*KU: F = 1.30053, p = 0.263778
N = 32 (teams)



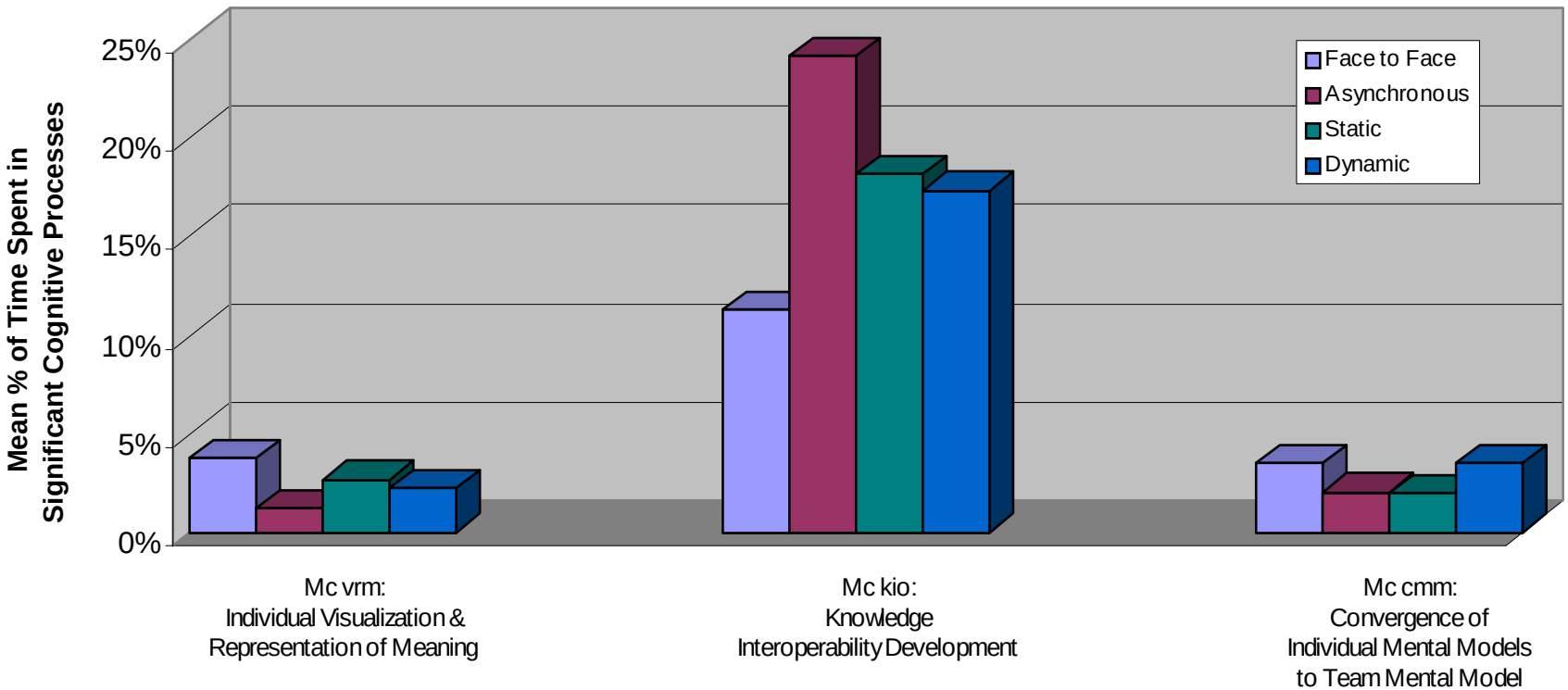
CASC Phase II Results
(verbal protocol analyses)

Mean % of Time Spent in Significant Cognitive Processes by Team Problem Solving

Mc vrm:
Individual Visualization
& Representation of Meaning
CM: F = 6.83871, p = 0.014206
KU: F = 0.21610, p = 0.645619
CM*KU: F = 0.74289, p = 0.396057
N = 32 (teams)

Mc kio:
Knowledge
Interoperability Development
CM: F = 14.1314, p = 0.00078
KU: F = 0.0630, p = 0.803688
CM*KU: F = 1.1837, p = 0.285872
N = 32 (teams)

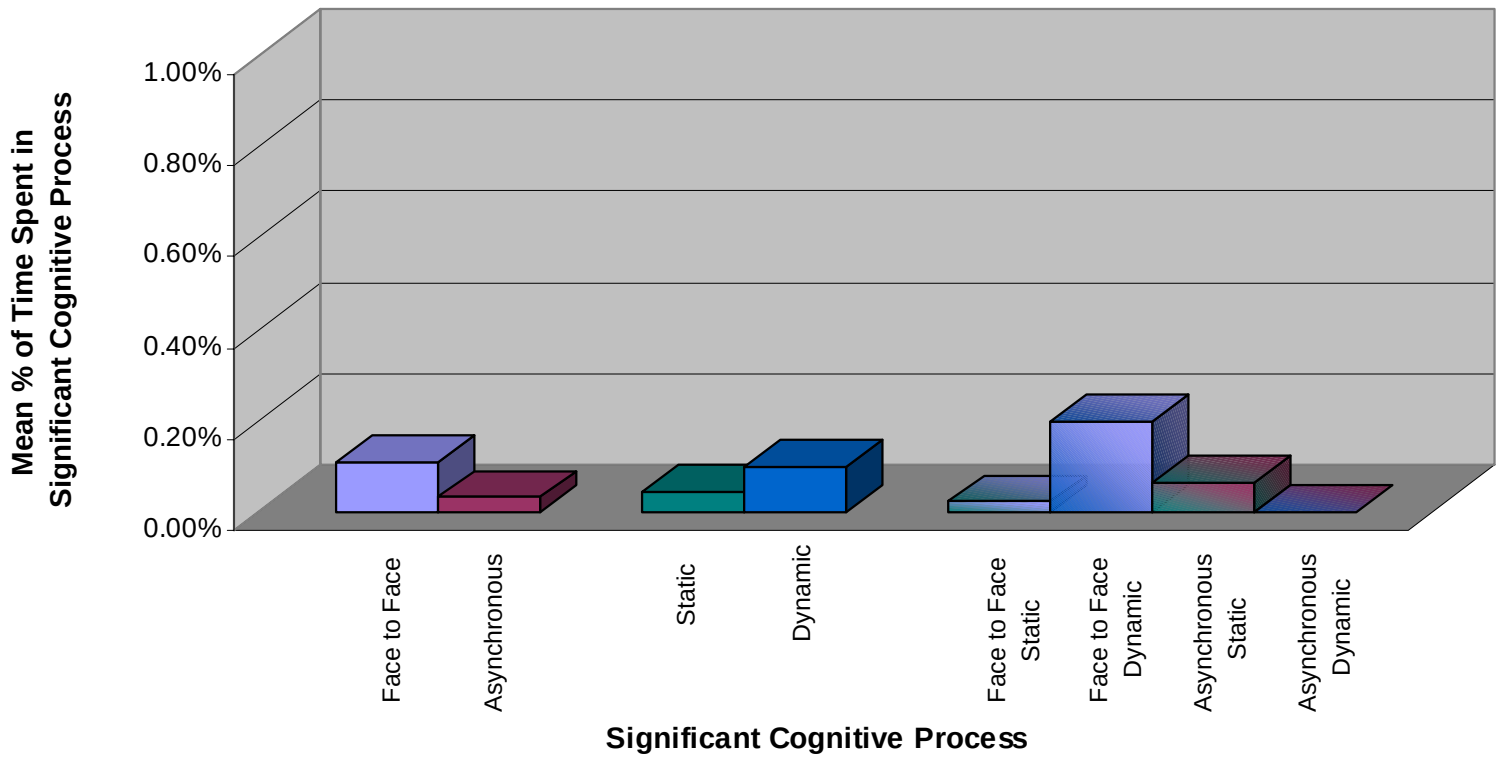
Mc cmm:
Convergence of Individual
Mental Models to Team Mental Model
CM: F = 4.06083, p = 0.53581
KU: F = 4.52292, p = 0.042392
CM*KU: F = 0.00929, p = 0.923090
N = 32 (teams)



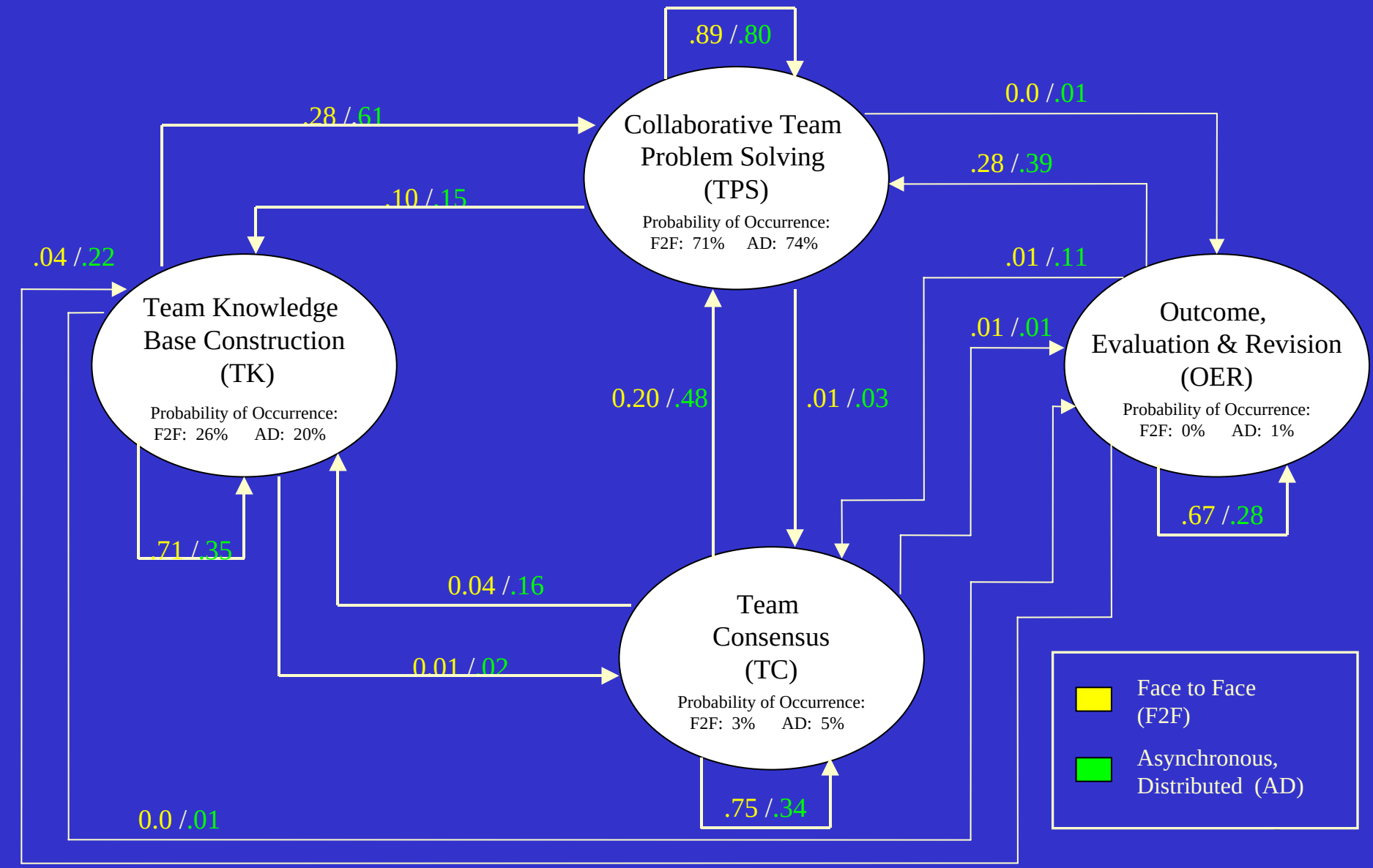
CASC Phase II Results
(verbal protocol analyses)

Mean % of Time Spent in Significant Cognitive Processes by Team Consensus

MC cmm:
Convergence of Individual
Mental Models to Team Mental Models
CM: F = 4.9790, p = 0.033841
KU: F = 0.0486, p = 0.827031
CM*KU: F = 0.2603, p = 0.613895
N = 32 (teams)



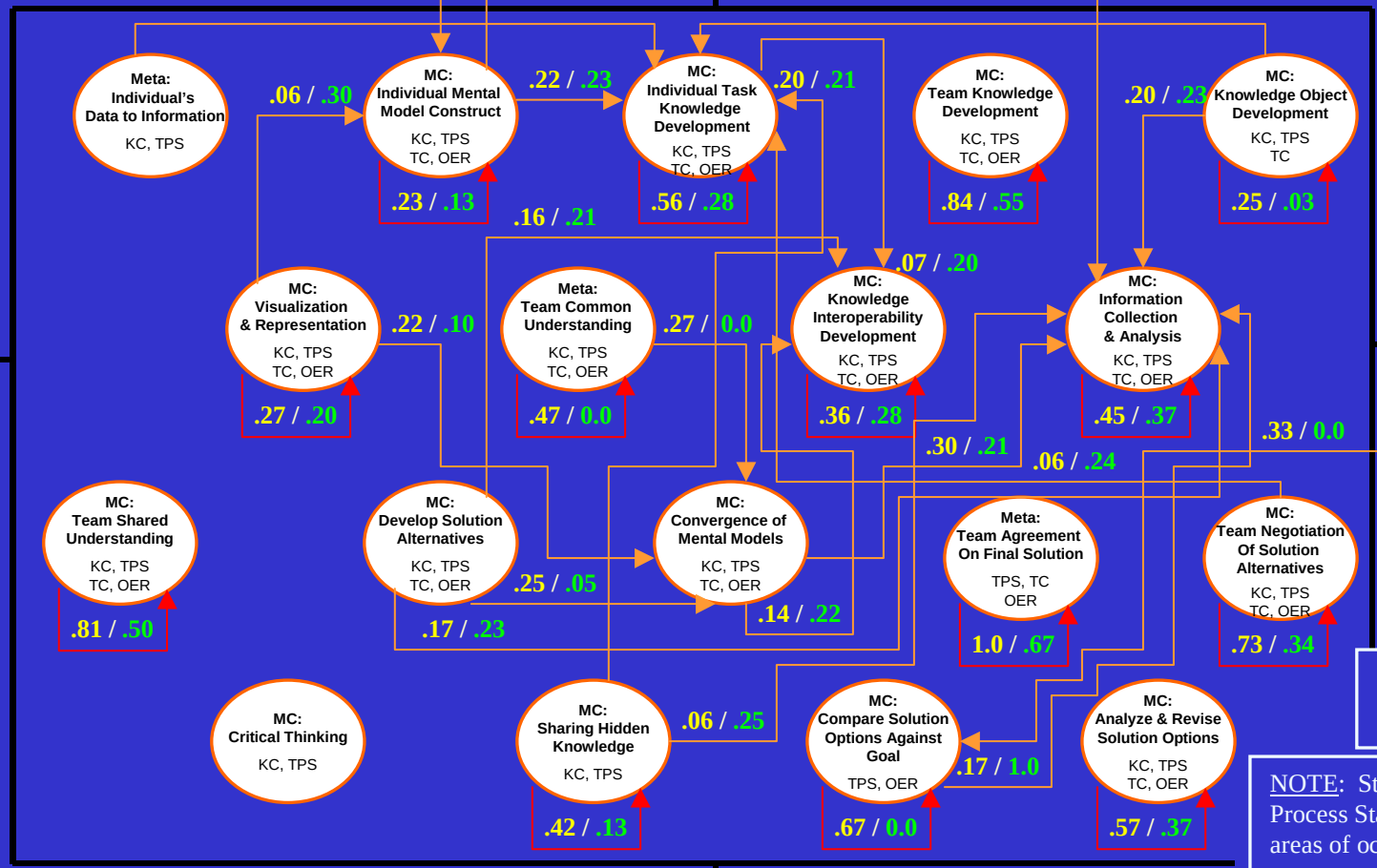
Transition Probabilities: Collaboration Stages



Transition Probabilities: Process States

Team Construction (KC)

Team Consensus (TC)



Team Problem Solving (TPS)

Face to Face (F2F)

Asynchronous, Distributed (AD)

Outcome Evaluation & Revision (OER)

Meta: Meta-cognition

MC: Macro-cognition

NOTE: Stages noted below Process State titles indicate areas of occurrence.

Transition probabilities are represented only if at least one value of the Face to Face/ Asynchronous pair is ≥ 0.2.

CASC Phase II Conclusions (outcome measures)

- ***There were no significant difference in time to complete NEO scenario between face-to-face and asynchronous, distributed teams***

  * these results differ from the literature with asynchronous, distributed teams taking longer to complete tasks than face-to-face teams
  * difference from current literature could be due to realistic complexity of NEO scenario task along with the 60 minute time constraint (I.e. time pressure) to solve problem

- ***The face-to-face and asynchronous, distributed teams achieved the same high quality solution in the same amount of time but the asynchronous, distributed teams required less communication***

  * results suggest that the structure of the Ewall environment (I.e. the cards coupled with the modules) permits more effective communication and collaboration compared to the face-to-face team environment
  * results suggest that the Ewall asynchronous, distributed teams could focus on the problem better and communicate more relevant information and knowledge between team members.

CASC Phase II Conclusions

Collaboration Stages

- **Results support that both face-to-face and asynchronous, distributed teams go through the four collaboration stages, Knowledge Construction, Team Problem Solving, Team Consensus and Outcome, Evaluation and Revision**

  * Asynchronous, distributed teams made significantly fewer utterances in the four collaboration stages compared to the face-to-face teams due to the structure of the Ewall environment

  * Face-to-face teams spent significantly more time in *knowledge construction* while the asynchronous, distributed teams spent significantly more time in *team problem solving*. Data suggest that Ewall helped focus team problem solving behavior

CASC Phase II Conclusions

Mean Percent of Time Spent in Significant Cognitive Process States

Knowledge Construction

* During knowledge construction the face-to-face teams spent significantly more time in ***individual task knowledge development, individual visualization & representation of meaning, and convergence of individual mental model to team mental model*** compared to asynchronous, distributed teams

Team Problem Solving

* During team problem solving the face-to-face teams spent more time in ***individual visualization & representation of meaning*** compared to asynchronous, distributed teams

* **Asynchronous, distributed teams spent more time conducting *knowledge interoperability* between team members than face-to-face teams**

* Dynamic teams spent more time in ***converging individual mental models to the team mental model*** compared to static teams.

Team Consensus

* During team consensus there is a significant interaction with ***convergence of individual mental models to team mental model*** between collaboration mode and knowledge uncertainty. Face-to-face, dynamic teams spent the most amount of time followed by asynchronous, distributed, static; face-to-face static and then asynchronous, distributed dynamic.

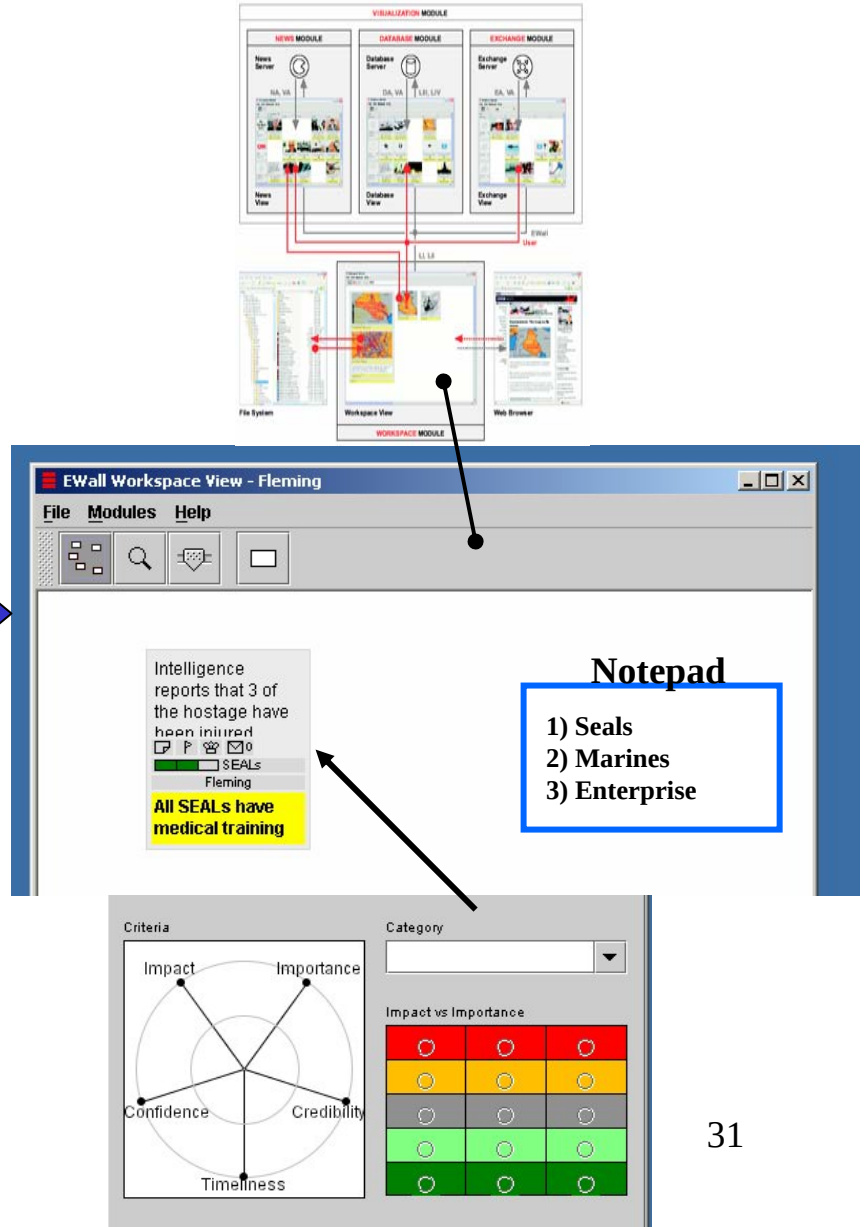
Summary Conclusions for Team Collaboration Model

CASC Phase I and II Experiments

Cognitive Process States	Collaboration Stages: Knowledge Construction	Team Problem Solving	Team Consensus	Outcome, Evaluation & Revision
individual mental model construction	✓			
individual task knowledge development	✓	✓	✓	
visualization & representation of meaning	✓	✓		
knowledge interoperability	✓	✓		
iterative information collection	✓		✓	
team shared understanding	✓			
develop solution alternatives	✓	✓		
convergence of mental models	✓	✓	✓	
team agreement on a solution			✓	
team negotiation of solution alternative			✓	
team pattern recognition				✓

CASC Team Collaboration Model
Knowledge Construction Representation

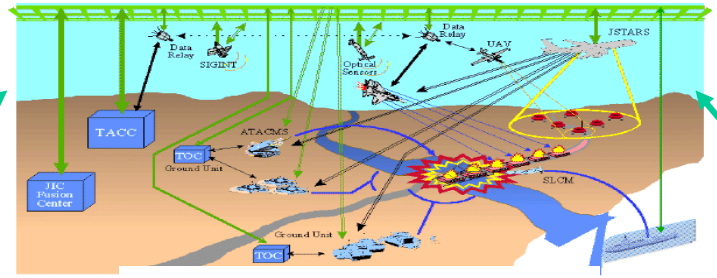
Cognitive Process States	Knowledge Construction
individual mental model construction	✓
individual task knowledge development	✓
visualization & representation of meaning	✓
knowledge interoperability	✓
iterative information collection	✓
team shared understanding	✓
develop solution alternatives	✓
convergence of mental models	✓

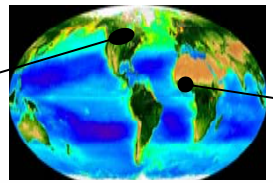


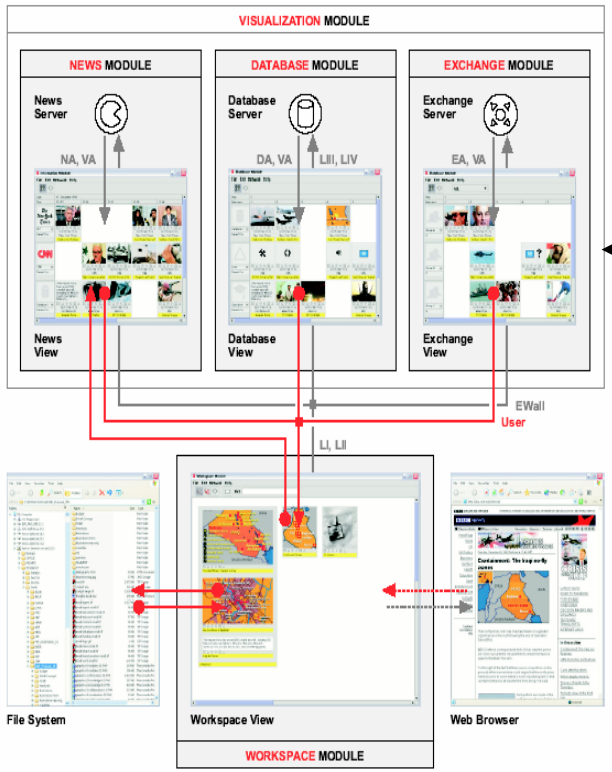
<u>Note</u>: Representation for Team Problem Solving And Team Consensus TBD in FY05

ForceNet Transition

Network Centric Information Grid

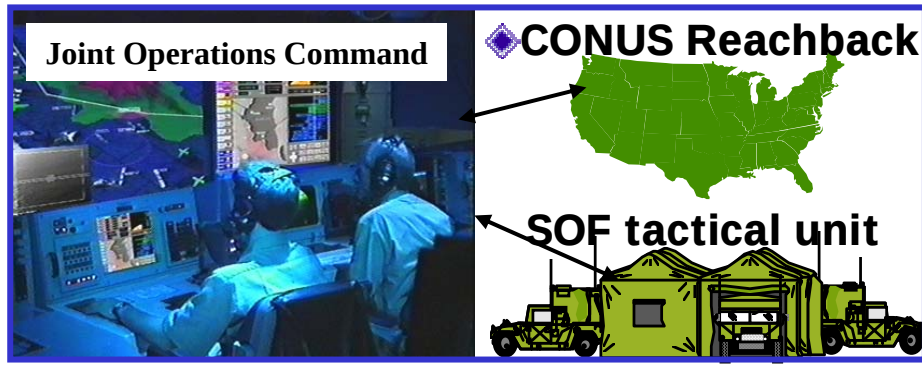






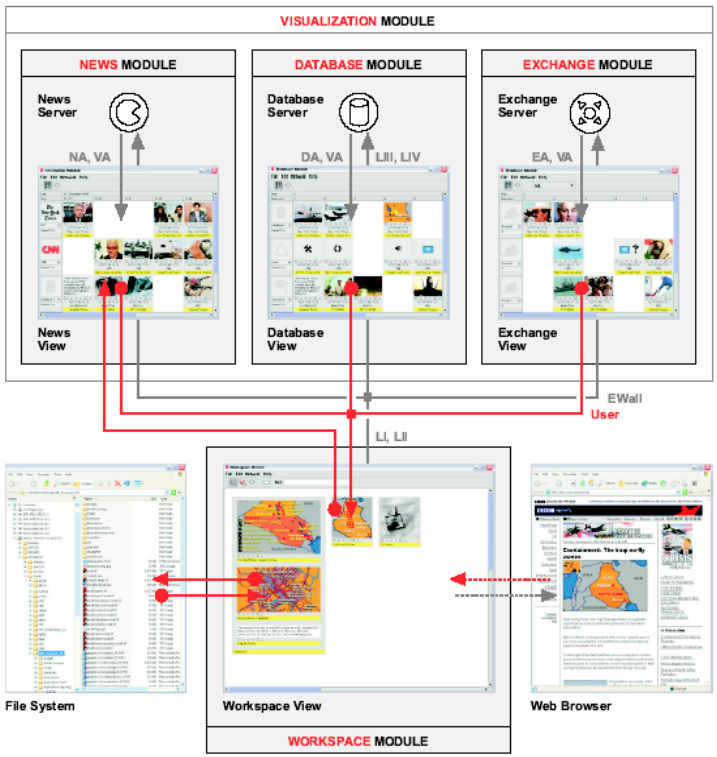
Asynchronous, Distributed Ewall Collaboration Tool With Agent Based Collaboration Support

Special Warfare Transition



Asynchronous, Distributed Ewall Collaboration Tool With Agent Based Collaboration Support

- More timely and accurate mission decisions (C2 down to individual warfighter)



- Improved intelligence, mission planning and execution

NAVAIR Testbed
Ewall Demonstration with Special Warfare Scenario

E-Wall as a Collaboration Tool
for Intelligence Analysis, and Mission Planning
for Special Operations Forces

The Hunt For Saddam Hussein

- Complex and difficult mission
  - Many sympathizers, family, friends
  - Extensive preparations for personal survival
    - Body doubles, numerous palaces, large cash reserves and foreign bank accounts
    - Previous attempts on life created very effective survival techniques
  - Yet, large disaffected population and ethnic groups
    - Many hated regime and see his demise as a positive development
- Requires massive intelligence effort
  - Fusion of hundreds of analysts, nodes, feeds
  - Networks across various nations, agencies, services, commands

Illustrative SOF Planning Cycle

- Intel (J-2) feeds system
  - Analyze and assess intelligence “take” (fusion)
    - All source, all types, many “feeds”
    - When Intel becomes actionable, *provide target locations*
  - J-2 pass info to Planners (J-5)
- Planners conduct mission feasibility analysis
    - Unit level personnel plan tactics, Hq. personnel coordinate platforms and other unit support
    - Briefback to commander, if approved, execute mission
- Operations (J-3) executes and monitors mission
  - After mission, intelligence take feeds process again

Intelligence Categories

- HUMINT (Human)
  - Iraqi Sources, “Walk in” information
  - Detainee interrogations; Document exploitation (DOCEX)
  - Cooperative governments; Overseas sources
- IMINT (Imagery)
  - Satellite Imagery
  - UAV Imagery
  - Ground tactical imagery
- SIGINT (Signals)
  - Telephone intercepts
  - Radio intercepts
- OSINT (Open Source)
  - Foreign Broadcast Information Service
  - News reports
  - News Channels
- MASINT (Measurements and Signals)
  - Thermal infrared heat imaging
  - Effluent/debris collection

Planning Elements

- Intelligence
  - Location (s)
  - Threat information
  - Movement patterns
- Cartography and geodesic products
- Friendly issues
  - Locations/number/availability of personnel
  - Equipment/aircraft/vehicle limitations and availability

Operations Execution

- Joint Operations Center (JOC) monitors 24/7
  - Variety of live feeds inc. Common Operational Picture, variety of satellite comm. nets, live streaming video (when available), weather, chat
  - During mission execution, significantly higher manning
    - Personnel coordinate across comm. Nets, across systems, react to tactical situation
      - Actions could include retasking personnel/assets, coordination with other/higher Hq.

EWall News view

Following 2 slides intended to represent end of one day and beginning of next

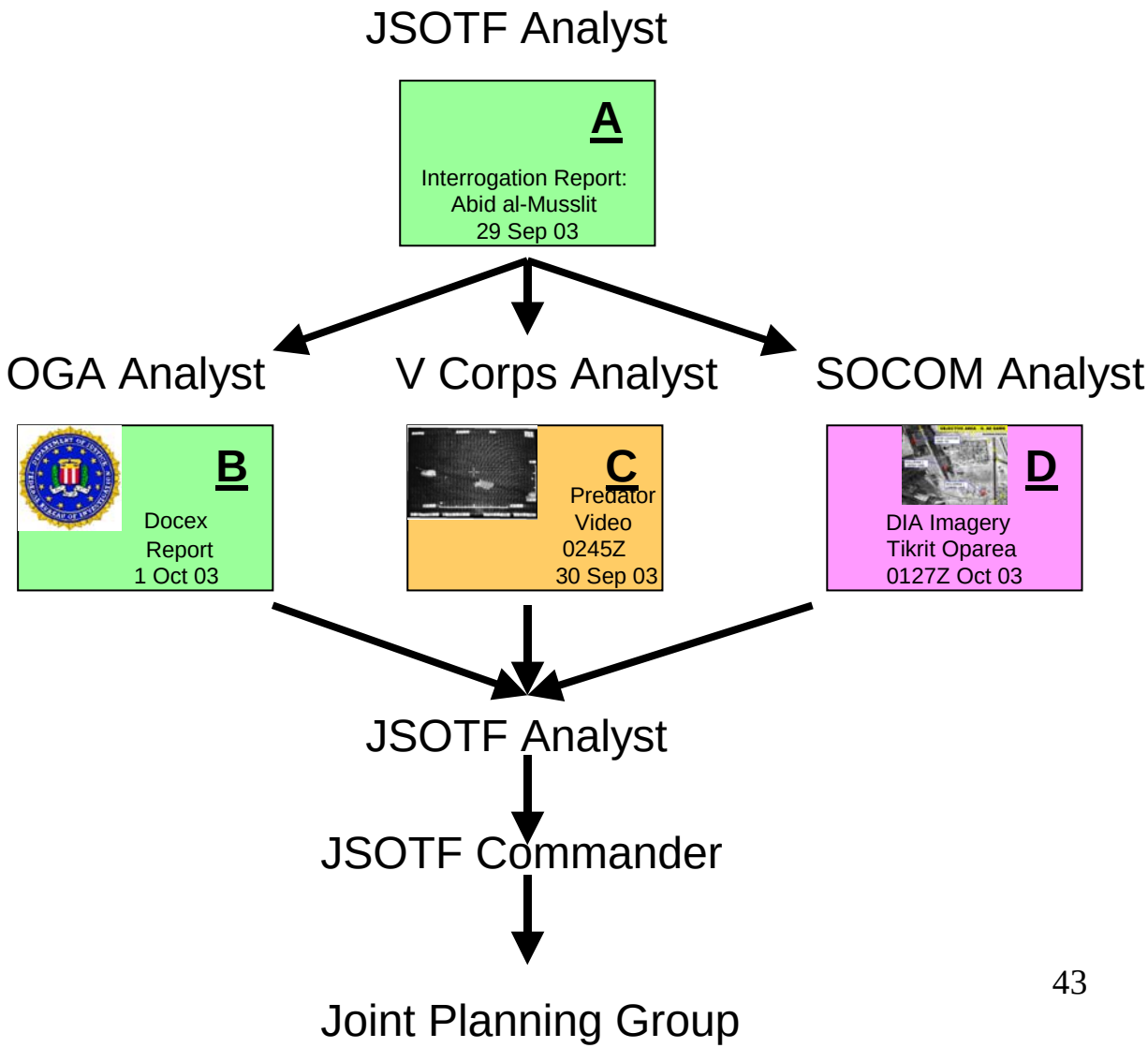
30 Sept 2003	2000Z	2100Z	2200Z	2300Z	0000Z
OGA/Foreign Reports	HUMINT Report Baghdad 29 Sep 03	UK MoD Daily Report 28 Sep 03	Financial Analysis: Swiss Banking Deals 25 Sept 03	Interrogation Report: Al Mustafa 29 Sep 03	Daily Report 28 Sep 03
OSD/DOD Agencies	DIA COMINT Intercept Tikrit Oparea 29 0315Z Sep 03		DOD Update 27 Sep 03		NGA Update 26 Sep 03
Combatant Commanders	CENTCOM Daily Brief 29 Sep 03			SOCOM Analysis Hussein Family 24 Sep 03	
CENTCOM Components		5th Flt ISR Imagery 30 0500Z Sep 03	ARCENT Daily Report 29 Sep 03	JTF-7 Update 29 Sep 03	
In-Country Units		1st Brigade Spot Report 27 1123Z Sep 03		Daily Ops Summary 30 Sep 03	Walk In HUMINT Report 0234Z 29 Sep 03
JSOTF/ subordinate units	JSOTF Docex Analysis 0916Z 28 Sep 03		JSOTF Daily INTREP 28 Sep 03		JSOTF Daily SITREP 0104Z 30 Sep 03
Open Source	BBC Report: Osame's Hideouts 28 Sep 03		Weather Channel Update 1100L 29 Sep 03		CNN Report 25 Sep 03

EWall News View

1 Oct 2003	0100Z	0200Z	0300Z	0400Z	0500Z
OGA/Foreign Reports	SASR Tactical Report 29 Sep 03	UK MoD Daily Report 29 Sep 03		**A** Interrogation Report: Abid al-Musslit 29 Sep 03	**B** Docex Report 1 Oct 03
OSD/DOD Agencies	**D** DIA Imagery Tikrit Oparea 0127Z 28 Sep 03			DOD Update 27 Sep 03	
Combatant Commanders		CENTCOM Daily Brief 1 Oct 03		USSOCOM Update 1 Oct 03	
CENTCOM Components	F-14 Imagery 1118Z 30 Sep 03		**C** Predator Video 0245Z 30 Sep 03		JTF-7 Update 1 Oct 03
In-Country Units	1st Brigade Spot Report 1123Z 30 Sep 03		3ID Humint Report 1612Z 30 Sep 03	Spot Intel Report: Ratline 0234Z 29 Sep 03	Daily Frago 0247Z 1 Oct 03
JSOTF/ subordinate units	JSOTF Docex Analysis 0916Z 28 Sep 03	JSOTF Daily INTREP 28 Sep 03		Ops Summary 0104Z 1 Oct 03	
Open Source	Fox News Update 1 Oct 03			Headline News Update 1700L 1Oct 03	

Intel Sequence

- JSOTF Analyst sends card to three separate analysts, at three different organizations in three different locations, all working together for locating Saddam Hussein
- Analyst separately check their databases and information, sending information to the JSOTF
- JSOTF analyst prepares report for the commander recommending location as potential target
- CDR agrees and directs information to the JPG for detailed planning

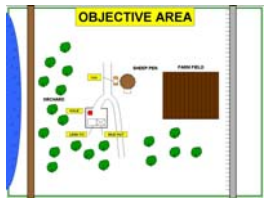


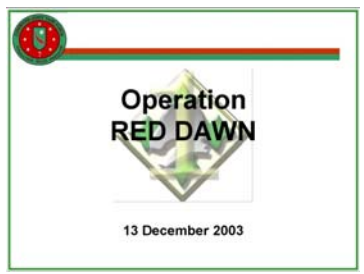
Joint Planning Group

- Joint Planning Group receives bundled Intelligence Assessment with CDR's direction to plan mission
- JPG Main prepares draft briefing and sends it to supporting locations: Special Forces, 3ID, Aviation Support Element, CVGB, etc
- Using E-wall, planners provide real time collaboration to JPG Main, providing unit level inputs, final product is briefing for JSOTF Commander

Draft Briefing

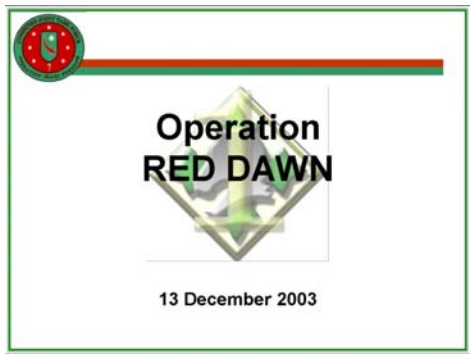
Various inputs from various locations





Final Ops Brief

- Intel Analyst found initial starting point, relayed to three locations for further information and analysis including confidence level of information
- Intel Analyst prepared recommendation to Commander, Commander concurred and sent information to JPG for detailed mission planning
- JPG conducted collaborative planning and put together Draft briefing for JSOTF Commander
- He approves, directs mission and JPG passes to Joint Operations Center for mission execution



JSOTF Executes Mission while JOC monitors

Ewall
Special Warfare Scenario
Demonstration

FY04 Accomplishments

- ***Completed CASC phase II experiment*** examining asynchronous, distributed team collaboration using a realistic NEO collaborative scenario within a Ewall collaboration environment resulting in a better understanding of the cognitive mechanisms used by these teams
- ***Transitioned CASC Phase II data sets and NEO scenario*** to Peter Foltz, ACT and Jared Freeman, Aptima to support related CKM research. Sending data sets to Nancy Cooke, ASU.
- ***Completed Collaboration Advisory Tool (CAT) empirical evaluation***
- **Papers / Presentations**

Warner, N. and Wroblewski, E. The Cognitive Processes used in Team Collaboration during Asynchronous, Distributed Decision Making. Paper presented at the Command and Control Research and Technology Symposium, San Diego, Ca. June, 2004.

Wroblewski, E. and Warner, N. *Decision Support and Automation Technology to Improve the Warfighter's Tactical and Strategic Decisions*. Presentation at the Naval Air Systems Command Technology Showcase, China Lake, Ca. May 2004.

Warner, N. and Wroblewski, E. *The Process of Achieving Collaborative Knowledge In Asynchronous Collaboration.* Presentation at the Collaboration and Knowledge Management Workshop, University of San Diego, San Diego, Ca. January, 2004.

Warner, N., Letsky, M., and Cowen, M. Model of Team Collaboration. Informal Peer Review, October, 200

- **Updated NAVAIR Collaboration Testbed**
  - Current Ewall software (Aug 2004)
  - NEO scenario with Ewall
  - Ewall demonstration with Special Warfare scenario
- **Established Transition Vehicles for CKM Products**
  - Special Warfare Command
  - Joint Forces Command

Backup Slides

CASC Phase II
Definitions for Collaboration Stages *

Knowledge Construction: (KC) "Team members reading, clarifying information and understanding the problem."

1. Individual team members reading information
" I need to read mine" (reads specific environmental information)
2. Clarifying information
"isn't the port guarded?"
"the rebel forces consists of 500 trained solders (*Stating the facts without applying that knowledge to any possible solution*)
3. Understanding the problem
"The goal is to save the people." (Realizing what they have to accomplish.)

Collaborative Team Problem Solving: (TPS) "Team members communicating data and knowledge to develop solution options to the problem." (solution options are defined for each of the five components of the final plan --- i.e. personnel, transportation, weapons, critical times and detail plan)

1. **Analyzing** the data to come up with a solution
"if they fly the helo high enough over enemy lines that gives us a way in and out"
2. Using data to **justify** a solution
"we could use the navy seahawk as it can hold up to 11 extra people; the 7 man team the navy uses plus the three workers that is ten people so you have space on the helo for everybody"
3. Developing, rationalizing and discussing solution alternatives
"If you take two seahawks over there that's four machine guns and plenty of missiles for A/A and A/G"
4. Establishing a plan of approach.
"Let's think it through"
5. Convincing others of a specific thought without absolute consensus of the final solution
"you want it to be pretty dark by the time you get to the church" ---- "Yeh"

Team Consensus: (TC) "Team negotiation of solution option and final agreement by all team members on a particular option." (solution option can be any one of the five components in the final plan)

1. Agreeing on the final solution
"So we should go straight from the army base? –"Yeh"; "Yeh"

Outcome Evaluation & Revision: (OER) "Team evaluation of selected solution option against problem solving goal. Team revises solution option if option does not meet goal." (solution option can be any one of the five components in the final plan)

1. Choosing to accept the final decision or revise it
"Use the C-130 to parachute army rangers into a mile of church; drive truck to church & pick up people and drive one mile to pick up point by blackhawk"
--- CHANGE SOLUTION OPTION: "drop rangers at church using blackhawk and pick up people using hoist in a second blackhawk"

Additional Stages: (MISC) "Other unique team behavior not described in the above categories. Need to describe unique behavior and label stage."

1. Any utterance that isn't applicable to any other collaboration stage.

* = *confirmation utterances like "yes", "yeh", "alright" during any of the stages should be associated with there respective utterance(s).*

CASC Phase II
Cognitive Process Definitions

(see definitions of data, information, knowledge and wisdom. Bellinger, G., Castro, D., and Mills, A. (2004), http://www.systems-thinking.org/dikw/dikw.htm)

1. Metacognition dti: individual conversion of data to information = individual team member converting data to information.

- "I noticed the rebels don't have night vision and it's foggy in the morning till 10 am (*data*); that's to our advantage (*information -- no action*)"

2. Macrocognition imm: individual mental model construction = individual team member, using available information, develops his/her mental picture of problem situation.

- "It's two in the morning in Jan. and Jan. is the rainy season for this island; the island is 750 miles north of Australia and is mostly rain forest and vegetation; can only get battleships within a mile of coral and at low tide can't get a single man raft onto the island; before noon heavy fog and by noon it will be gone"

3. Macrocognition itk: individual task knowledge development = individual team member asking for clarification to data or information; response to clarification.

- "isn't the port guarded?"(clarification)
- "Yes, the port is guarded" (response to clarification question)
- "How do we get around the rebels?" (clarification to strategy question)
- "I am the environmental expert" (clarifying data)
- "We have 5 minutes remaining" (clarifying data)
- "yes, the seals are better in water" (clarification of facts)

4. Macrocognition tk: team knowledge development = All team members participate in clarifying (i.e. answering a question) information to build team knowledge.

- "Is there windows in the church?" (E) --- information
- "Eight windows in the church" (W) --- information
- "Eight windows in the church" (I) --- information
- "The only problem is they are not going to do us any good because they (workers) are in a inside room" (I) --- information
- "They are all external rooms, they (workers) are not in an external room" (I) --- information

5. Macrocognition ko: knowledge object development = pictures, icons or standard text, developed by an individual team member or the whole team, that represents a standard meaning to the team.

- "weapons expert, type our responses to the final plan on the form"

6. Macrocognition vrm: individual visualization and representation of meaning

Visualization = individual team members use methods (e.g. graphs, pictures) to transfer meaning to other team members

- "team members use scenario map(s) to exchange distance information between objects like the enterprise and the island"

Representation = individual team members use methods to sort data and information into meaningful chunks

- "using yellow note pads to sort data into categories"

7. Metacognition cu: team integration of individual knowledge for common understanding =

all team members combine individual pieces of **knowledge** to achieve a common understanding.

"I think we should come in at 7:00am because fog comes in at 6:00am and it will help us"(W)
"I agree it's still dark & rebels have no NVG" (I)
"I also agree because its critical that we do the mission covertly" (E)

8. Macrocognition kio: knowledge interoperability development = team members exchanging ***knowledge*** among each other.

- "we need to take them out of the church before noon"(derived knowledge from data and information)
- "I don't think the SEALS should be used (negative solution with no justification)
- "I think the Army is best" (no justification)

9. Macrocognition ica: iterative information collection and analysis = *collecting* and *analyzing* information to come up with a solution but no specific solution mentioned.

- "It seems we have better NVG capability than the rebels" (providing analyzed information)
- **"**I think we should first start talking about our expertise" (i.e. approach to develop a solution)
- "Are we trying to go up on the roof?" (i.e. clarification of plan)

10. Macrocognition tsu: team shared understanding development = discussion among all team members on a particular topic or data item (i.e. discussion does not involve answering questions)

- "No we have no translator that speaks drapoize" (I)
- "But it says we have a translator" (W)
- "He is highly skilled in many different languages" (I)
- "Then what you are hoping is that there is a translator on the island that speaks draponize and another language that our translator also speaks" (E)

11. Macrocognition sa: develop, rationalize and visualize solution alternatives = using data to justify a solution

- "alright if we are looking at the navy we could use the navy seahawk; it can hold up to 11 extra people"

12. Macrocognition cmm: convergence of individual mental models to team mental model = convincing other team members to accept specific data, information or knowledge

- "That sounds really good"
- "I see what you are saying"
- "Yes" (confirmation by an individual)

13. Metacognition cs: team agreement on a common solution = all team members agree on the ***final plan***.

- "I agree with the final plan" (W)
- "I agree also" (I)
- "Yes" (E)

14. Macrocognition tn: team negotiation of solution alternatives = team negotiation of solution alternatives ending in a final solution *option*. **(solution options are defined for each of the five components of the final plan --- i.e. personnel, transportation, weapons, critical times and detail plan)**

Weapons Example:

- **"**F-18 for backup cover' (E)
- "(F-18) on standby" (W)
- "Yes" (E)
- "Used to take out oncoming enemy threat" (I)

15. Macrocognition tpr: team pattern recognition = the team as a whole identifies a pattern of data, information or knowledge.

- "It seems like all the **needed assets (SEALS, Blackhawk, F-18's)** are located on the USS enterprise"(E) --- needed assets are the patterned information.

- "Yes"(I)
- Yes (W)

16. Macrocognition ct: critical thinking = Team working together toward a common goal, whereby goal accomplishment requires an active exchange of ideas, self-regulatory judgment, and systematic consideration of evidence, counterevidence, and context, in an environment where judgments are made under uncertainty, and there is limited knowledge and time (Hess & Freeman, 2004).

1. **critical thinking is measured as a *composite* of:** (Warner & Wroblewski, 2004; Hess & Freeman, 2004)

   - **MCitk: individual task knowledge development** = individual team member clarifying data; asking for clarification.
     - "isn't the port guarded?"
   - **MetCcu: team integration of individual knowledge for common understanding** = one or more team members combine individual pieces of knowledge to achieve a common understanding.
     - "We need to figure out the critical time of when we can leave by each of us providing our leave times"
   - **MCkio: knowledge interoperability** = team members exchanging ***knowledge*** among each other.
     - "when we take them out it's got to be at night" (derived knowledge from data)
   - **MCsa: develop, rationalize and visualize solution alternatives** = using data to justify a solution
     - "alright if we are looking at the navy we could use the navy seahawk; it can hold up to 11 extra people"

   Note: one critical thinking frequency count = oneMCitk +oneMetCcu + MCkio + MCsa

17. Macrocognition shk: sharing hidden knowledge = individual team members sharing their knowledge through prompting by other team member(s).

- "When does the sunrise?" (W)
- "Isn't that your area of expertise" (I)
- "Ok, sunrises at 6:00am" (E)

18. Metacognition sag: solution adjustment against goal and exit criteria = team as a whole compares complete solution option (i.e. all five components of final plan) against goal and exit criteria.

- " Our solution options meet the 24 hr rescue requirement with minimum enemy contact" (I)
- "Yes" (W)
- "Yes" (E)

19. Macrocognition csg: compare solution options against goal(s) = team members discuss solution options (i.e. any of the five solution components) against the scenario goal (i.e. rescue 3 red cross workers within 24 hrs).

- **"** The Navy SEALS and the Blackhawk will meet the goal but our detail plan cannot be completed in 24 hrs" (W)
- "We need to re-look at the detail plan" (I)

20. Macrocognition aro: analyze, revise solution options = team members analyze final solution options (i.e. any of the five solution components) and revise if necessary.

- "We may need to re-consider using a window to get into the church"